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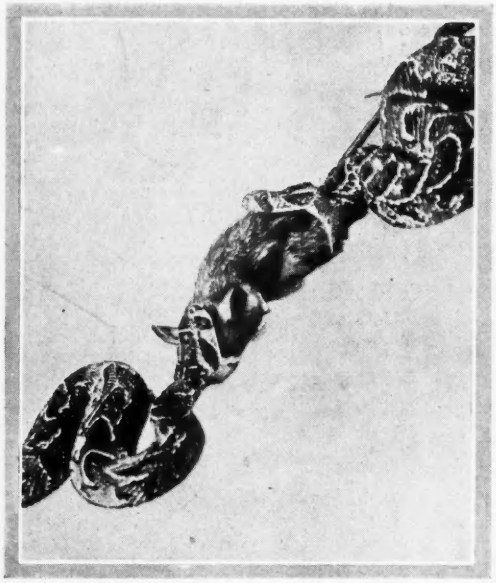

CANNIBALISM AMONG SNAKES
(See page 73)

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Notes of the Month.

While scientific inventions are rendering means of international communication increasingly simple, little progress has been made in overcoming the problem of linguistic differences. In Europe, no fewer than one hundred and twenty languages are spoken, all of which for the majority are mutually unintelligible; and although repeated attempts have been made to devise a language for international use, few have succeeded in capturing the popular imagination. Esperanto is possibly the best known, and certainly has the greatest number of adherents, but the number of Esperantists represents only a small proportion of those who constantly require to be in communication with persons of different nationalities. Professor Otto Jespersen, of the University of Copenhagen, who is an ardent interlinguist and himself invented the international language called Noval, has long contended that interlinguistics should be more widely recognized as a serious branch of science, and should be developed on scientific lines. Commenting in *Psyche* on the future of interlinguistics, Dr. Jespersen suggests that an international vocabulary must be primarily based on the Romance languages and English, but that such widespread cultural languages as German and Russian should on no account be neglected. Although Esperanto was introduced as long ago as 1887, the serious study of interlinguistics is still in its infancy; its achievements have yet to be seen. But a simple and comprehensive international language would be useful to many people in many countries. We suggest that the League of Nations might interest itself in the question.

* * * * *

As long ago as 1833 the excavation of the Agora at Athens was contemplated by the Greek Government, but owing to financial difficulties the project was postponed. Now, nearly a century later, the plan has been revived, and it is hoped to commence systematic excavations this spring. Several years ago the Greek authorities invited the American School of Classical Studies at Athens to undertake the work, and, now that the financial interest of an anonymous American has been enlisted, there is every prospect that the scheme will be shortly commenced. Demolition of the houses which at present occupy part of the site will be started early in the spring, and excavations will follow immediately. Professor T. L. Shear of Princeton University, who will direct the operations, will contribute an illustrated account of the project to our April issue. The market place was, of course, the centre of the social and industrial life of the Greek towns, and there is no doubt that systematic excavation of the Agora at Athens will add considerably to our knowledge of Greek history.

* * * * *

Further important discoveries are reported this month from Ur of the Chaldees, where work is proceeding under the direction of Mr. Leonard Woolley. The expedition has continued the clearing of the super-structure and underground tombs of the kings of the Third Dynasty, and work has been commenced on the residential quarter of the city. The most important discovery here has been a little chapel, dedicated to the goddess Pa-Sag, whose function appears to have been the protection of travellers along the desert tracks. The chapel dates from about 2,000 B.C., and was practically undisturbed. The statue of the goddess stood in its niche in the tiny sanctuary, and outside the door was one of the clay reliefs which had decorated the façade, a figure two feet high of a bull-legged demon. The statue of the goddess is neither beautiful nor of fine workmanship, but throughout the excavations at Ur statues have

*

been rare, and only one has yet been found complete. Apart from its other interests, therefore, the shrine of Pa-Sag ranks high among the discoveries at Ur.

* * * * *

Renewed efforts are being made in America to exterminate plant pests, and on another page we publish an account of the attack which is being launched against the pandora moth. The caterpillar causes widespread damage to pine trees, often stripping them of all their foliage. Some idea of the financial loss which results has been obtained by making a study of individual trees in areas where the moth has been at work. The loss sustained during a recent visitation in one region is estimated at several hundred thousand dollars. Although the infestation has declined, it will be many years before the trees which have suffered regain their normal rate of growth. The damage is not confined to the primary injury caused by the moth, for the impaired vitality of the tree renders it susceptible to attacks by bark-beetles. While insect pests have lately been much discussed, the opening at Kew of new headquarters for the Imperial Mycological Institute is a reminder of the existence of the equally deadly plant pests—fungi. The work at Kew includes the identification of specimens sent from all parts of the world and the collection of information concerning every kind of plant disease. Mycology is becoming an increasingly important branch of biological study, and the new buildings will accommodate the larger staff required to deal with the work.

* * * * *

Professor Elliot Smith's verdict on Peking Man has been eagerly awaited, following his visit to China to examine the material and to inspect the actual site of the discoveries. He has now pronounced the brain-case, discovered by Dr. W. C. Pei, to be the most significant and illuminating relic of primitive man ever recovered. In a lecture at Edinburgh University, Professor Smith surveyed the history of the discoveries relating to primitive man in China which have been made since the tentative identification of the first tooth as human in the early years of the present century. He pointed out that, owing to the conditions in which the relics from the cave have been found, there can be no question as to the dating of Peking Man. Judging from the associated animal remains, palaeontologists have no hesitation in ascribing early man in China to the Early Pleistocene Age, which may be put tentatively at a million years ago. As far as the remains bear upon the physical characters of early man, it is concluded that Peking Man stands midway between the Ape Man of Java and the Piltdown skull. It is, however, more primitive and generalized than either. According to Professor Smith, we are thus able to unite in a solid foundation the character of the three most primitive members of the human family as yet known, and the discovery also enables us to picture the nature of the common ancestor of all three, the hypothetical Pliocene man.

* * * * *

Dr. G. A. Reisner's recent lectures in Cairo on the funerary customs of the Ancient Egyptians were an illuminating survey of the evidence bearing upon the cult of the dead in the Old Kingdom which has been obtained from excavation at Giza and in the pyramid area. Dr. Reisner, whose lectures were reported in *The Times*, traced the development of the typical Egyptian stone tomb with its two parts, one for the deposition of the body, the other for the offerings, from its earliest form in the square pit excavated in the gravel. One aspect, perhaps not generally realized, is the serious economic burden on the population entailed by the cult. Apart from the labour employed in non-productive work over a long period of years in the erection of the pyramids, a large body of priests was engaged in ministering to the needs of the dead. Their existence was dependent upon grants of land in perpetuity to each of the original ministrants and his descendants in return for the maintenance of offerings to the *ka* at the funerary chapel of the dead. The cities housing these functionaries were exempt from taxation and forced labour, so that by the end of the fourth dynasty the country was supporting an army of priests large enough to feed the dead of centuries.

* * * * *

A discovery of great interest in relation to the rites which Dr. Reisner described is that of a sealed tomb of a woman, found near the Sphinx at Giza by Professor Selim Hassan, of the Egyptian University Expedition. Unrifled tombs of a date so early as the Fourth Dynasty —about 3800 to 3500 B.C.—are extremely rare. Expectations of interesting finds were fully justified when the tomb was opened. According to the official report, not only was the body of this relatively obscure woman richly decked with gold and jewelry, but there were features entirely new to Egyptologists. Among the jewelry was a gold fillet encircling the head, which bore ornaments of a kind not previously known. Each was in the form of two papyrus flowers with a bird resembling an ibis perched in the centre. More remarkable were reproductions of the hands and feet moulded in terra cotta, presumably to take the place of the natural extremities should these perish. Nothing exactly like these had been found before.

Why Did Andrée Fail?

By R. N. Rudmose Brown, D.Sc.

An expert here examines the diaries of Andrée, a translation of which has just been published, and concludes that the explorer's death was due not to cold or starvation, but probably to accidental suffocation by his Primus stove.

THE discovery in August and September, 1930, of Andrée's camp on White Island (Giles Land) has been promptly followed by the publication of the diaries and memoranda found on the bodies of Andrée and his companions.* The admirable translation from the Swedish not only gives every scrap of documentary evidence available, but contains full discussion of the journey by various Swedish and Norwegian experts.

The Story Revealed.

It was on 11th July, 1897, that S. A. Andrée, N. Strindberg, and K. Fraenkel left Danes Island, Spitsbergen, in their balloon *Örnen* (*The Eagle*), in an attempt to cross the Arctic Ocean via the Pole in the interests of geographical discovery. Less was known of the inner polar regions in those days than at present, and there was the possibility of unknown land in high latitudes. From that day until the autumn of last year, thirty-three years later, the only news of the expedition was derived from floats and carrier pigeons liberated within the next two days. Now the whole, or nearly the whole of the story is revealed, and even illustrated from films recovered at the camp on White Island.

The venture was not foolhardy. Andrée had experience of polar regions, and was an expert balloonist. He knew the risks he was taking, and guarded against them as well as he could, but he argued that the only road to the heart of the icebound Arctic Ocean was by air. The balloon, which was filled with hydrogen at Danes Island, had a capacity of 170,000 cubic feet. Somewhat elliptical in shape, it was built of triple varnished Chinese silk covered with a net of Italian hemp soaked in vaseline. The top had an outer cap of single varnished silk. In addition to valves there was a bursting arrangement for tearing the silk and emptying the balloon.

Realizing the necessity for steering to enable the balloon to move at an angle with the wind, Andrée devised a system of three drag lines, or guide ropes, weighing in all about sixteen hundredweight and with a total length of 1,100 yards. These were to drag over ground or ice and would check the rising of the balloon, while if the balloon fell, the relief in weight by greater lengths of the ropes being on the ground, would increase its buoyancy and so help to keep it afloat. The upper end of the drag ropes was hempen; the lower end was cocoanut fibre. There was a screw arrangement by which if the ground end was caught it could be detached by twisting the rope. Andrée's reluctance to adopt this device was justified by later events. In addition, there were ballast ropes. Three sails, with a total area of 818 square feet, were fitted to the balloon. These were for use when the drag ropes were functioning by reducing the speed of the balloon below the speed of the wind. The balloon was constructed to carry about 6,000 pounds, and to be gas tight for thirty days. It was planned to sail at an altitude of about 800 feet.

The start was inauspicious for the drag ropes became detached, and thus the balloon was free and unsteerable. For ten and a half hours the flight continued to the north-east. In sunshine the balloon rose to 1,600 or 2,310 feet, and there was loss of gas. In cloud and fog, which were frequent, it fell. Then a drag rope was improvised from the ballast ropes, and the balloon was kept at lower altitudes; but it had lost gas, and was dangerously low. The steering did not work, and the sails seemed only to press the balloon down. The wind took it west, then it lay stationary for some hours in a calm and then again moved east and north-east. Fog was bad; the balloon bumped on the ice; ballast was thrown over in vain, and at last, at 8 a.m. on 14th July, the men landed safely on the ice in lat. 82° 56′ N., long. 29° 56′ E. They had been sixty-five and a half hours in the air, and had travelled a total distance of 372 miles but an effective distance of only 288 miles.

Unfavourable Weather.

So far, the weather had not favoured the expedition, although the winds had been largely of the nature that Swedish meteorologists had anticipated. The liability to fog in Arctic regions in the month of July had been underestimated. On an average, July has about twenty days of fog in the area between Spitsbergen

* *The Andrée Diaries.* (John Lane, 21s.)

and Franz Josef Land and to the north. Ekholm, who had originally been meteorologist to the expedition but did not sail in the balloon, had reckoned on only one or two days' fog at the most. This fog, condensing on the balloon, gave a heavy layer of water and ice which further reduced the buoyance, already decreased by the high altitudes at the start subsequent to the loss of the guide ropes.

A Camp on the Ice.

The stranded men made a camp on the ice and rescued practically everything left in the balloon, but a good deal, including provisions, had already been thrown out in the hope of giving the balloon buoyancy. They decided to make for Franz Josef Land, where a big depôt in a good log house awaited them at Cape Flora. All the equipment necessary was at hand, including three sledges and a canvas boat. For, although Andrée had firmly believed in his flight succeeding, he carried ground equipment much as a liner carries boats and lifebelts. The distance to Cape Flora in a straight line was 210 miles, and there was always the possibility of unknown land being discovered on the way.

The men set off cheerfully on 22nd July, and in Andrée's diary and Strindberg's letters their daily lot can be followed. But the drift of the pack thwarted all their efforts. They were in the sweep of the trans-polar current towards the south. The pack was rough and the way arduous. They lightened their task by discarding food and other things, for bears, seals, and birds could, and did, afford them food. At length, on 4th August, they decided to make for the Seven Islands, north of North-East Land, where another depôt had been placed.

But this attempt was no more successful, and on 17th September they seem to have accepted as inevitable a wintering on the pack, and started to build a snow-house. Andrée estimated that their course would carry them between Spitsbergen and Franz Josef Land. He wondered if they might make one of the islands east of Spitsbergen, provided that the current carried them to the open sea. In that case they would be relatively safe, for there were several houses and hunting camps in Spitsbergen. But their frail canvas boat would have stood little chance among the brash ice and quickly moving floes at the edge of the pack.

The drift became quicker and bore them south towards White Island, which had been in sight for about three weeks. An eddy in the current swept their floe round its southern end. It was shattered, and their snow-house destroyed, but on 5th October they scrambled ashore on the south-west coast, and evidently contrived to save practically all their gear, since the relics found tally closely with lists in the men's diaries soon after the collapse of the balloon.

From this date the records became scanty. Andrée's diary ended on 2nd October, but in a small memorandum book he made a few pages of later notes. These are almost undecipherable, but clearly cover only three or four days. Then the book is blank. Strindberg kept his observation book with calculations of positions, list of stores, and some bills of fare until 2nd October, and he also entered brief notes in an almanac on some days from 11th July to 17th October. These scanty notes and the material evidence suggest that on getting ashore the three men set about choosing the site for a camp. White Island is about seventeen miles long and ten miles wide, and is almost entirely covered by an ice-cap that rises to 660 feet. At the south-west corner, where the men landed, the beach rises gradually from the sea to an ice free strip of land some three miles long and a quarter of a mile wide. In summer, walrus frequent this beach and near at hand ivory gulls nest. Apparently a rocky ridge, sixteen to twenty feet high, occurs on this bare ground some 250 yards from the sea and rather further from the ice. The camp was made on its north-western side.

The remains of the balloon were evidently used for a tent, the flaps being weighted with a whale rib and driftwood. As on so many Arctic beaches, driftwood occurs on White Island, and some had evidently been collected. The fragmentary words decipherable in Andrée's diary on 6th October give the impression of interest in the new surroundings and a hope of a continuance of the scientific observations which he had made while on the drifting pack-ice. Strindberg's almanac records "reconnoitring" the same day and on 7th October "moving," and the last entries in Andrée's memorandum book seem also to refer to moving their possessions to the selected site. Then there is silence until the last entry by Strindberg on 17th October, "Home 7.5 a.m." That is all.

Last Days.

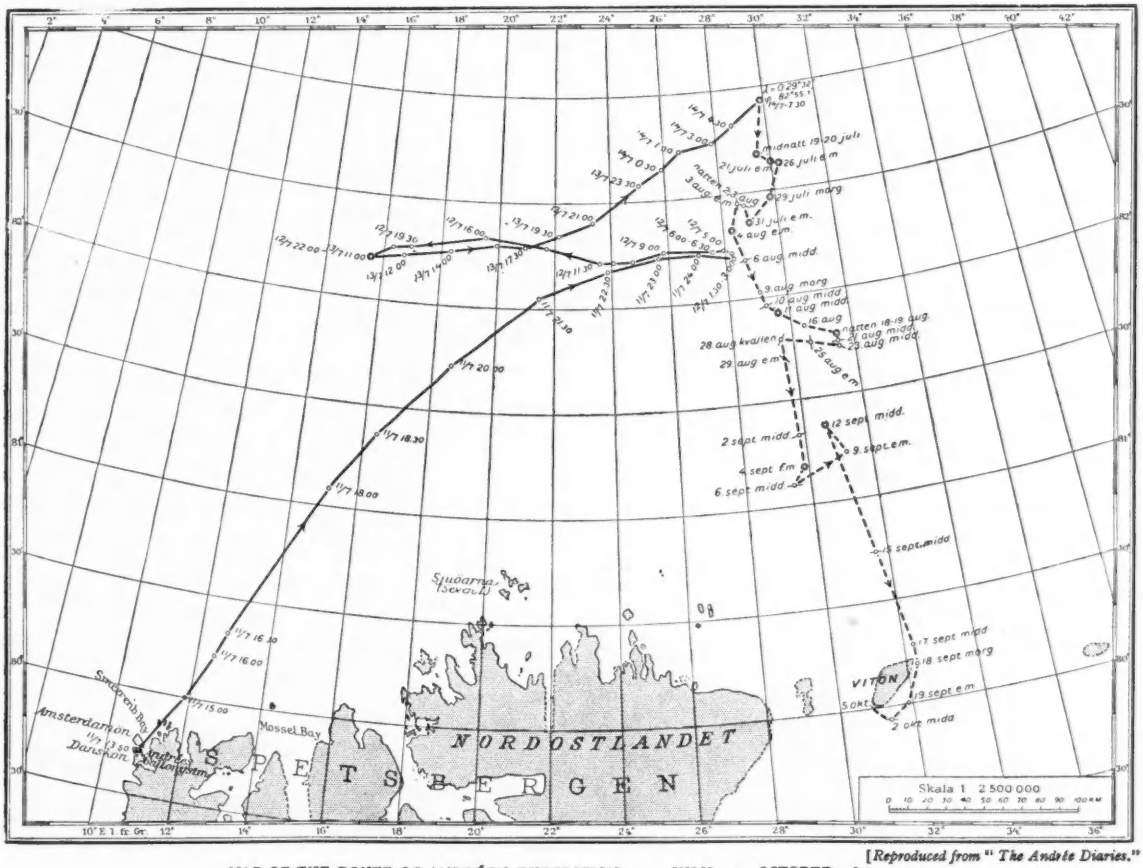
The story of the last days must be pieced together from scraps of material evidence and probabilities. Strindberg evidently died before the others, since his body was buried. He may have been the victim of an accident. But the other two were found on what must have been the floor of the tent, with the sleeping bag lying between them. They would appear to have died approximately at the same time. Hunger cannot have been the cause; there is ample evidence that they had still some provisions, and, moreover, bones

of bears and birds show that on the island, as on the ice, hunting had been a source of food. Bears are plentiful in that part of the Arctic, and seals would also be obtainable.

Three guns with 135 ball cartridges and 120 shot cartridges were found at the camp. It is suggested that the men died of cold since their clothing was not all that would be desirable for an Arctic winter. But they had chances to get bearskins, and if they felt the cold why did they lie down beside and not in their fur sleeping bag? Fraenkel's meteorological record ends on 3rd October, and until then the temperatures recorded only a few degrees of frost. It is unlikely that great cold was experienced in the first half of October, and we may assume that the end came soon after the last entry in Strindberg's log.

The journey from which they returned on 17th October was probably over the ice-cap or round the island perhaps, to look for better winter quarters or even to get a view westward from a greater elevation in order to gauge the possibility of a journey over the ice to Spitsbergen. On their return they had evidently unpacked some, but not all, of their gear. Two sledges were found nearly empty. Wandering bears may have raided anything left on them. The third sledge bore the boat, and was only partly unloaded: probably this was not used on the last land journey. But if the three men had long survived the return they would undoubtedly have completed the unloading of the boat when they prepared their winter camp.

We can suppose that on their return they accepted finally the necessity of wintering where they had landed on White Island. The prospect was dreary and even grim, but not hopeless. There was no reason why they should not expect to live. Men have survived a polar winter in worse circumstances. They had every prospect of sufficient food, and driftwood and blubber for fuel. Clothing, if somewhat poor, could be supplemented with skins. The tent might have been protected with snow walls. Lastly, they had plenty of matches. The following spring a journey west to



[*Reproduced from "The André Diaries."*

MAP OF THE ROUTE OF ANDRÉE'S EXPEDITION, 11TH JULY—5TH OCTOBER, 1897.

Spitsbergen would have been a light task compared with what these men had come through. To North-East Land via Great Island the distance would be about forty miles compared with the two hundred miles they had already covered. Then they would be comparatively safe in travelling another two hundred miles along the coast to a large depôt and good house at Mossel Bay, in the north of Spitsbergen. A search expedition would certainly look for them there even if they were not picked up along the course of their journey by some hunting sloop.

Andrée knew enough about Arctic conditions to realize that chances of escape and rescue were good. There is not the smallest likelihood that any of the men were despondent : as far as the written records go they were hopeful, and Andrée himself, when he had time to write, was full of interest in the problems around him, collecting and preserving samples of algae, sand, and shells on the ice. The life, if hard, was healthy, and it is impossible to suppose that all the men died of disease ; with the supply of fresh meat there certainly was no scurvy.

The only plausible theory to account for the deaths of Andrée and Fraenkel is that they were suffocated by the action of their Primus stove. An Arctic tent has little ventilation, and possibly this improvised tent had none when the entrance was closed. Evidently the stove had been in use for it was half full of paraffin and in perfect working order when found. It might conceivably exhaust the oxygen in the confined space when the two men were lying waiting for some pot to boil and dozing perhaps as they waited. Mr. V. Stefansson suggests that carbon monoxide, liberated from the stove, may have poisoned them. It is possible, even if not likely, but no other explanation fits the facts.

The present volume gives only the diaries of Andrée and Strindberg, and summaries and commentaries on the evidence. It is a popular work, and is to be followed by the publication in the Swedish *Geografiska Annaler* of Fraenkel's meteorological log, descriptions of samples collected and other scientific matter.

Textile Designs : Exploring a New Field.

CRYSTALLIZATION appears to have been almost entirely ignored as a source of natural design, and the familiar decoration on the frosted window still remains to be explored in the field of design motive. The micro forms of crystals are clearly defined, of course, by means of polarized light, and since they are a natural production, they possess unusual harmony not merely between form and colour but in the aggregate of shades of which colour schemes are composed. By a touch of the fingers, the design motive in crystallization may be shown in a succession of colour harmonies, extending almost, if not entirely, through the full range of all known colour.

An instrument has now been invented for projecting slides showing forms of micro crystallization by means of polarized light, and was demonstrated by Mr. F. G. Wood, the inventor, in a recent lecture at the Royal Society of Arts. Specimens of micro crystallizations which are considered particularly applicable to design motives in textiles were shown. The principle of polarization used in the instrument is that obtained by reflection from a bundle of glass plates. The prism rotates, as does the stage which carries the slide, and a recess is provided in the stage for holding mounted discs of mica and of selenite ; these are capable of independent rotation through a quadrant of arc. It is thus possible to obtain a practically unlimited range of colours and tones. A swinging bracket carrying a right-angled glass prism brings it, when required, in front of the analysing prism ; this deflects the projected image vertically on to the table, where it may be conveniently studied, copied, or photographed. In demonstrating, the glass prism is swung aside, and direct projection is effected on to the normal type of screen.

It was observed during the demonstration that not all the crystallizations respond equally to polarized light. Some are of such a texture that a succession of soft colourings readily appear, and by subtle changes present a series of fabric suggestions. These are generally such as show little or no colour without the use of the mica or selenite ; others show more pronounced and vivid colourings. Many crystallizations offer floral or fernlike suggestions, while others suggest intricate scrollwork, simple mosaics of patchwork, " all-over " ornamentation, or broad sweeps of colour. Others again are jazzlike. No two crystallizations are alike. With some substances great variation is shown ; others display some similarity if produced under identical conditions.

The slides shown at the demonstration are to be known as " krystlmots," and the instrument, although primarily devised for projecting this type of slide, may also be used in micro projection generally.

Cannibals of the Snake World.

By F. W. FitzSimons, F.Z.S.

Director of the Port Elizabeth Snake Park.

Snakes are so secretive by nature that a study of their habits in natural haunts is difficult. Observations are now being made at the Port Elizabeth Snake Park, where cannibal species are the subject of special study.

THE Suffragettes of pre-war days flattered themselves that they had discovered the "hunger strike," but Nature had anticipated them. Snakes have known all about it for thousands of years, for they are ascetics compared with other meat eaters, not excepting human beings. When the pangs of hunger grow too great the snake slithers from its lair and captures a rat, a frog, a bird, or even a fellow snake and swallows it whole. A rat will suffice for a full two weeks, but a snake never grows alarmed if no further food should come his way. Weeks go by and as long as it can get an occasional drink, the snake is content. For instance, I once had a python in Natal, a giant who resented the curtailment of his liberty and refused to eat. For nineteen months it did not touch a thing, and what was more surprising was that when we put its favourite guinea pigs and fowls within its reach, it still ignored them.

Contrary to popular belief, the victims do not show the slightest fear when in close proximity to pythons. I have even seen an old rooster square up to a python and peck viciously at its head. During a period of quiescence, rats and guinea pigs have actually nibbled at a python while the reptile just watched sleepily, although a single snap of his jaws would have demolished them. In their native haunts snakes are so secretive and furtive that it is difficult to discover much about their habits and peculiarities, and we therefore kept them for observation in large enclosures at Marisburg in Natal. Later the Port Elizabeth Snake Park came into being and here we endeavour to discover as much as possible of both dangerous and non-poisonous reptiles.

The cobra is a notorious cannibal, and its fondness for snakes forms a costly item in our expenditure. During the summer season, which is the time when snakes feed, we usually have upwards of fifty cobras of different varieties, and the number of smaller snakes they ate was so appalling that we were forced to find separate accommodation for the would-be victims. A cobra simply will not look at a plump frog as long as *skaapstekers* are available, and these are worth at least half-a-crown apiece! They are quite common, of course, as are night-adders, and when frogs are really scarce we often give the cobras a snake diet.

AT THE SNAKE PARK.

This photograph, taken at the Snake Park, shows a formidable python in the hands of a native assistant.

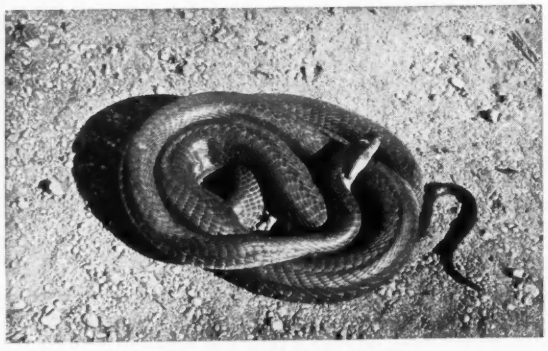
Wandering through the Park one morning, I saw quite thirty Cape cobras of the black-necked species, Egyptian and ringhals, busily occupied in swallowing other snakes. "Frogs are finished, sir," said the assistant, "but we have droves of skaapstekers, night-adders, and house snakes, so I have just put fifty of them in for the cobras to feed on!" Mentally I made a quick calculation of the fifty half-crowns. We pay policemen and soldiers for protection while we go about the daily business of collecting food, but the cobra cares not a jot if it loses its life in the quest. In the absence of its favourite skaapsteker it will tackle any snake. One day I watched a hungry Cape cobra give battle to a large black mamba, also an aristocrat of the reptile world and always ready to resent an affront to its dignity. The assistant was

anxious to stop him, for there were only two black mambas in the Park.

But I knew that it was already too late. The mamba must have been bitten several times, and it would surely die, so we let them fight it out. Sure enough, after a while the mamba turned over on its back and died, while the cobra, apparently none the worse, released its death grip and commenced to swallow the corpse. Slowly, like a sluggish stream, the body of the victim seemed to flow into the cobra until nearly half had disappeared. Then a convulsive trembling shook the cobra, running from head to tail and repeated many times. Suddenly all movement ceased, and the eater of other snakes was dead, slain by the venom which it had injected into its enemy.

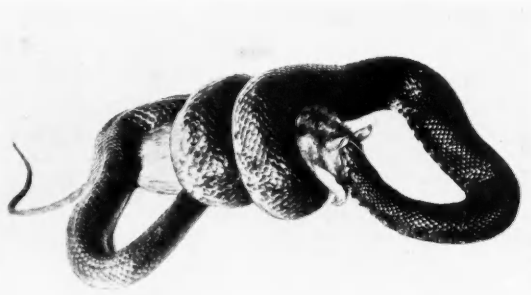
On another occasion a cobra gave battle to a puff-adder, not for the sheer love of fighting but simply to secure a good meal. But the puff-adder is a sullen, illtempered fellow, and a powerful scrapper into the bargain. Its hiss of warning from scrub or rock is sufficient to stay the boldest man or beast in his stride. The cobra launched the attack with a fierce bite, aiming at the neck to prevent its opponent from biting back. But the stroke missed, and simultaneously the adder embedded both fangs deep into the cobra. The smart of the pain enraged the enemy, for it bit savagely again and again, while the adder in spasmodic bites pumped venom into it. Puff-adder poison is extremely deadly to man and beast, but it is slow in comparison with that of the cobra.

A man may live for twelve or even twenty-four hours after injection, because a lethal dose causes slow but extensive internal haemorrhage and it takes longer than the nerve poison of the cobra. In this case the puff-adder suddenly unsheathed its fangs, struck blindly here, there, and everywhere for a moment or two, and



THE VENOMOUS BLACK MAMBA.

The Black Mamba is one of the most deadly of the poisonous snakes. Its bite is certain death to man or beast unless anti-venom serum is liberally injected.



A MOLE SNAKE WITH ITS PREY.

The South African mole snake is a non-poisonous species. It constricts its prey and swallows it whole. The digestive powers of the snake are remarkable.

then collapsed. The cobra then commenced its meal, while I ordered black Johannes to sit on the wall and note how soon the victor would die. This occurred when it had swallowed two-thirds of the victim.

In the Snake Park serpents frequently become cannibals by accident, and during the summer this is almost a daily occurrence. A snake siezes a frog and begins to swallow it head first. Seeing the commotion, other snakes arrive and one at least is sure to sieze an unoccupied hind leg. The desire to suck it in is dominant, and soon the noses of the opposing snakes meet. They are stubborn creatures, especially where food is concerned, and when neither will let go the the larger of the two laps its jaws over the lesser. Sometimes the smaller one gets in first with an enormous gape and a powerful forward thrust, so that it engulfs its bigger cousin. Struggle as it will, the victim cannot extricate its head, which, together with the frog and its whole body, eventually disappears. The victor, well content, crawls sluggishly away to find a quiet corner in which to lie and enjoy the fruits of its recent energy.

These sights are too common to excite much interest in the habitués of the Park, but visitors think otherwise. They gather in groups and watch eagerly, often with disgust. But all the same, not a single woman will on any account leave until the whole "disgusting" spectacle is over. They remain fascinated until the performance is finished. Twice I have seen a sight which really did rouse even our blasé interest. A file snake captured a frog and, in the very act of sucking it in, a couple of inquisitive night-adders came along. The first promptly pounced upon one of the frog's hind legs while the second seized the other. Soon their jaws reached the victim's thighs, while those of the rightful owner had absorbed the hind quarters. Then three noses met. The two night-adders

commenced to struggle, not to eject the frog's legs, but to get a better grip on them !

But the file snake had a huge gape and the most powerful thrust. With a heave which had its origin in the tail, the reptile distended its jaws to the uttermost, and engulfed the lot ! At last the dinner-thiefs realized their peril, but it was too late. It was obvious that the battle was won, but the point was would the victor disgorge its prey ? Not a file snake ! After the frog and the two night-adders had completely disappeared we took up the winner tenderly, and placed him in a box padded with cotton wool to see how long his meal would take to digest. It was fifteen days before X-rays revealed to us that every particle of flesh and even the bones of the victims had been digested by the reptile's powerful gastric juices. Previously the file snake had been somewhat emaciated, but now he was noble to look upon, sleek and handsome !

Snakes are stubborn creatures, and will put up a bold fight for life when attacked. With occasional exceptions, however, they do not assume the offensive. Sometimes a cobra, with body erect and hood fully expanded, will drop suddenly to the ground and charge, but if one turns and runs it will not follow for more than a few paces. Its object seems to be to drive one so far that it can meanwhile slip away safely into the herbage. Not so the black mamba. It is never certain what it will do, and this species is, therefore, the more dangerous. One gave me the fright of my life when I startled it in the act of devouring a bird. It dropped its prey and slipped into a disused termite mound, and I foolishly prodded it out with a stick !

Out it shot, hissing defiance. I made a swipe at it, missed, and then found my hands really full. It came straight at me, jaws agape, and in the fraction of a second I was on the run ; I never made better time ! After a record half mile I looked back, and was thankful to find that the brute had given me up and had gone back to its interrupted meal.

In the early days before we had produced an effective anti-venom serum, I went through an unpleasant experience. I had been helping in the removal of some rotten fencing posts and thrust my hand into one of the holes to remove the rubbish. Unfortunately, there happened to be a puff-adder in occupation, and, before I could move, the reptile had bitten me at the base of the thumb. All that could be done was to scarify the punctures and to put a ligature on my arm. At intervals I sucked the wound, and although a doctor had been sent for it was highly probable that he would arrive too late. It is not a pleasant experience to sit quietly watching your hand, wrist, and arm slowly turning purple. The veins swell, the hand grows nearly twice its mormal size, while the throbbing is intense. Then the ligature had to be taken off, and soon the whole of my shoulder and breast grew discoloured. Twelve interminable hours passed before the crisis passed, and I knew that I was safe. My own experiences in this direction, however, cannot compare with those of Johannes, the Kaffir Park attendant. On many occasions he has been actually on the border line between life and death as the result of adder or mamba bites. Once he was badly bitten by a puff-adder, and to make assurance doubly sure, twice the normal amount of anti-venom serum was injected into him. His belief in the " white man's medicine " is pathetic, but in this case he had reason on his side ; within forty-eight hours he had completely recovered.

A TUG-OF-WAR BETWEEN TWO PUFF-ADDERS.

Two puff-adders are competing for the same prey. When their noses meet the stronger reptile swallows the smaller as well as the rat. This is common in the Snake Park.

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A Travelling School of Geology.

By Frank Debenham.

Much is being done by the International Summer School of Princeton University to encourage mutual sympathy and understanding between Europe and America. It is the first organization of its kind which brings senior European scientists into close personal contact with students from the United States.

PERHAPS no nationality of students is more engaging in its independence, its frank point of view, and its absence of self-consciousness than the American. It is possibly this fact which has so largely contributed to the success of the Princeton Summer School. Last summer, Princeton University successfully carried out the fifth season of its International Summer School of Geology and Natural Resources under the able directorship of Professor Richard M. Field, the founder of the organization. The school is a travelling one; that is to say, a party of some twenty-four men journeys round the United States for five weeks, travelling in a specially built Pullman car.

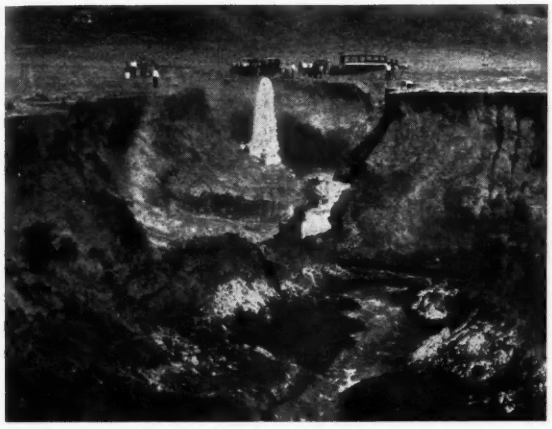
Before the trip had lasted a week the foreign professors were realizing how likeable was the personality of the American undergraduate, and realizing how little essential difference there is between the youth of different countries. It was this spirit of camaraderie, added to the varied activities, such as exploring mines, examining oil fields and climbing mountains, which produced a happy party from beginning to end. Let me quote an instance or two to prove the point. The Grand Canyon is a hot place at any time, but in a heat wave such as reigned throughout most of last summer in America it was, to the average person, beyond a joke. Yet to the party of twenty or so, toiling up five thousand feet, from a temperature of 104 degrees at the bottom to one of 98 degrees at the top, it was a joke—most of the time; and when it was no longer a joke it was a German professor who helped on the tired ones. It was the same German professor who thoroughly enjoyed, even if he did not understand, the laugh which arose when, in a lecture describing granites, he said they sometimes contained "seldom gems" (Anglice, rare minerals).

The car in which the school travels can, in a few moments, be converted into a dormitory, a café, a lecture room, or a play room. It is true that when everybody decides to get up for breakfast at the same moment, or when, dusty from a long tramp, the whole party urgently desires the one shower bath, the space proves to be a little inadequate, but I suggest that it is through the minor trials of life such as these that the internationally minded scientist will learn better to appreciate his fellows in other countries. In short, I feel that I know my German confrères on this trip all the better for having trodden on their toes and been trodden upon in return. Similarly, the one suitcase of clothing which is allowed each man is perhaps at first sight rather short commons, but as soon as the spirit of the school is understood the question of propriety of clothing is forgotten.

THE VALLEY OF THE SHOSHONE.

Members of the Summer School climbing the chasm caused by joint erosion in the valley of the Shoshone River.

Not even the photographs could do full justice to the variety and scarcity of garments used by the party on its travels. Thus, on the first day canvas miners' caps were issued to the party for going down a coal mine; they came to the surface again somewhat the worse for wear. But a proportion of the Princeton undergraduates clung to their canvas caps, and wore them on every occasion throughout the tour. Curious headgear is the rule rather than the exception in the States, and if the professors from Germany and Czechoslovakia and England did not exactly follow suit, they were certainly at their ease in clothing that



AN ARTESIAN WELL IN MONTANA

Within nine years this artesian well has excavated the canyon in the foreground. Behind are members of the party with the cars in which they travelled.

would be remarkable in Europe. One might recite in the glow of reminiscence the many things that were seen and the incidents that lightened the trip, but it is the purpose of this article rather to bring out the spirit of the school and the atmosphere in which it travelled.

The work done was naturally of an observational character for the most part, since one can hardly expect detailed work from a scamper of fifteen thousand miles in five weeks. But the itinerary was so well planned that before we had tired of the geology of Indiana limestone, for instance, we were presented with the problems of the Mississippi at St. Louis, thence to the structure of Texan oilfields, the wonders of the Grand Canyon, and the irrigation methods of Southern California. Each night we were comfortably removed to a new point of departure and a new subject for study.

Most interesting of all were the days spent in and near to the Yellowstone National Park, for in that vicinity there was a geological party, under Professor Thom of Princeton, engaged in important stratigraphical work. They were ready to interrupt their work to show the travelling party their methods and their discoveries. This region, to the south and west of Billings in Montana, is a paradise to the geologist, not because of any lack of complexity in the geology, but because erosion and dry conditions have exposed the formations ready to his eye. I can imagine no area better suited for training a geological surveyor, nor one more intriguing to the student of land forms.

In Yellowstone Park itself it was the privilege of the party to do a small but important piece of constructive work by identifying certain beds as glacial and not fluvial, and so discovering a new phase in the history of the Canyon. It was Professor Field who made the discovery, and it is left to his able pen to record it and its meaning in due course.

Thereafter short visits to Duluth, St. Paul, Chicago, and Niagara Falls in rapid succession left one rather amazed, but very satisfied when the party reached the beautiful academic atmosphere of Princeton again. Scientific tours of the United States are not a new thing of course, nor is this unique instance of scientific hospitality, but what is new in the scheme thus annually carried out by the Council of the International Summer School is that it brings into the closest touch senior scientists from Europe and junior scientists, undergraduates, from the States.

There is but one closer form of co-operation left, and that, too, has been thought of by the Council, I believe, namely to include in the party undergraduates or very junior graduates from Europe. There are already several organizations which, like the Commonwealth Fund Fellowship Foundation, are doing much to encourage mutual sympathy and understanding between America and Europe, and the Summer School may be counted high in the list, a list, moreover, which is almost entirely American in origin. It was peculiarly fitting, too, that in this particular tour, the name which stands so high in international co-operation and education was represented by an undergraduate of Princeton, a grandson of Mr. John D. Rockefeller, senior. If the cementing of friendships between scientists of different nations be a measure of co-operation in their work, then the Princeton Summer School tour of 1930 will assuredly have done much to further that good cause.

SINTER TERRACES IN YELLOWSTONE PARK.

This is not a snowdrift. The geologists are examining the sinter terraces in Yellowstone Park, which surround and kill the trees.

British Universities To-day: (11) Leeds.

By Sir Michael Sadler.

Vice-Chancellor of Leeds University, 1911-1923.

In spite of the difficulties which marked its early years, the University of Leeds has developed on a scale which has far surpassed the first hopes of its founders. New buildings are now in course of erection.

THE growth of the University of Leeds, its distinction in scientific and literary studies, its strong hold upon the affection of those who have shared in its life, and its cordial relations with the citizens of the area which it principally serves, make an encouraging and significant chapter in the modern history of English university education. Of the sixteen universities in Great Britain, Leeds is eleventh in seniority and tenth in size. Among the nine modern universities in England it is fifth in age and fifth in the number of students engaged in full-time studies for degrees or diplomas or in research.*

Pioneer Work.

The beginnings of what is now the University of Leeds were beset with difficulties. But its pioneers were foreseeing, patient, and tenacious. Guided by the experience of Owens College, Manchester, they showed very great wisdom in their choice of the first group of professors. Feeling that national opinion was moving steadily towards some great extension of higher education in the populous north, they bided their time, were cautious in expenditure, untiring in their administrative labour, fortunate in the generous friendship of the Clothworkers' Company of London, and open-minded in giving consent to the gradual enlargement of the purpose with which they began their work. Fifty-six years of unflagging effort have achieved a result which goes far beyond the first hopes of the founders. But from stage to stage the work of what is now the University of Leeds has progressed with a steady stride until at length the Chancellor (the Duke of Devonshire), the Vice-Chancellor (Dr. J. B. Baillie) and their colleagues in the Council and Senate have the satisfaction of seeing in progress the operations which will rehouse the university in buildings worthy of its many-sided activity and well-adapted to its needs.

The accompanying photograph shows the beginnings of this reconstruction. Should it be asked why the university, when the time came for rebuilding on a very large scale, decided to remain upon a city site instead of removing itself to the large estate of two hundred acres which it owns in the suburbs of Leeds, and now uses as athletic fields with two halls of residence upon its fringe, the answer is that the present high-lying site which adjoins the spacious Woodhouse Moor is not so hemmed in by houses as one not knowing Leeds might gather from the photograph. Secondly, the area of the central enclosure of the university will, in future, be greatly enlarged by a diversion of the road which now passes in front of the present university buildings. A stronger consideration which favoured retention of the present site springs from the topography of Leeds: a suburban university would be inconvenient of access to a large number of students. A further argument in favour of the present site had great weight with those who were responsible for a decision. The active part taken on the University Council and its advisory committees by many leading citizens of Leeds and of the West Riding is characteristic of the Leeds tradition, and has enriched the university by devoted and generous service. This participation in university business on the part of busy laymen is made easy by the close neighbourhood of the university to the centre of the city and to the railway stations.

The new buildings will be impressive through their mass, dignity, contour and dominating position. Harp-like in ground plan, they will surround what remains of the older structure. They include a new Great Hall with reflectory, a students' Union, a block for Arts and administration, and nine departmental buildings, two of which are already finished. In the centre of the court, to which access is given through the main entrance, will stand the rotunda of the Brotherton Library. This splendid new library, due to the munificence of the late Lord Brotherton, who laid the foundation stone last year, will become one of the great libraries of England. It already contains 114,600 volumes, in addition to more than 30,000

*The statistics in this article are based upon the Report of the University Grants Committee, 1930, and refer to the academic year 1928-9.

pamphlets, and is the sixth largest among the modern university libraries in England. The Brotherton Library, when completed, will have accommodation for a million books. Last June, Lord Brotherton intimated his intention of leaving, with a special endowment, his own private library to the university in trust for the nation. In this famous collection, which includes a fine copy of the first folio of Shakespeare's works, scarcely any class of finely printed book is unrepresented. Its chief distinction, however, lies in its collection of mediaeval and other manuscripts.

But these, which are already transforming the University of Leeds, are not the only recent additions to its buildings. The Clothworkers' Company has generously defrayed the cost of an extension of the Textile Department. The new Dental School and Hospital, erected on a site provided by the Leeds Infirmary, is admirably planned and equipped. A new wing, for the accommodation of physiology and other departments, has also been added to the Medical School, and a new Pathological Institute adjacent to the Medical School is under construction.

The chief aim of the series of articles, of which this forms a part, is to discuss the governing policy of each university and to estimate its most prominent contribution to modern life and progress. So far, therefore, as the constitution of the University of Leeds is concerned, it must suffice to say here that the organization of its Court, Council, Senate, and Faculties is similar to that of the sister universities of Manchester, Liverpool, and Sheffield. But the stages through which the university has grown to its present strength throw so much light upon its characteristics and present position that a few words about its history will not be out of place.

The Medical Faculty.

The oldest constituent part of the present university is the Leeds School of Medicine, which was founded in 1831. For a century and a half Leeds has been a famous centre of medicine and surgery. The Medical School and the School of Dentistry, both of them in close association with the Leeds Infirmary, form an important part of the present university. The Medical Faculty, which comprises dentistry, includes nearly one-quarter of the students. But the actual nucleus of the present university was the Yorkshire College of Science, opened in 1874. In his admirable sketch of the history of the University, written in 1924, the registrar, Mr. A. E. Wheeler, says that "the causes which gave rise to the Yorkshire College of Science were many and varied. The growth of the Mechanics' Institutes (not forgetting the good work of the Yorkshire Union of Institutes), the increasing public appreciation of the value of education and of scientific and technical education in particular, the great Exhibition of 1851 and the growing belief in education as an aid to industry, the development of school teaching, and the influence of the Philosophical and Literary Society, founded in 1818; all these had their part in creating the atmosphere in which the College came into being.

A Central Science College.

"The immediate cause of this is to be found in the efforts of a Yorkshire Board of Education, whose threefold purpose was to secure the introduction of science instruction in day schools, to establish evening science classes, and to institute a central science college. The Board had been in existence only a few years, during which time they had made considerable progress with evening classes, when they came to the conclusion, in 1869, that the time had arrived for starting the central college. Many difficulties had to be overcome, the chief of them being that of getting money. At one time they came very near to giving up the project altogether; but fortunately they persevered, and, in the end, having failed to get anything like the modest sum they considered necessary, they decided to make a start in a small way, hoping that success would bring increased support."

But associated with the original promoters of the plan for a College of Science, and cherishing a much less narrowly utilitarian aim, were influential supporters (notably Lord Frederick Cavendish, its first President) who hoped that the College would in the end achieve something wider and more comprehensive than the terms of its original constitution implied. Their aspirations were put into words by Dr. Lyon Playfair at the opening meeting: "It would not be wise to give to the College too much of a technical character. The object of technical education, even in a technical school, is not to teach man how to use spinning jennies or steam hammers, but to give them a cultured intelligence, which may be applied to work in life, whatever that may be. . . . The movement which has led to the establishment of this College has no doubt received its primary impulse from the conviction that our industrial population ought to be educated in the principles which underlie their occupations. But the object is higher than this. A College of Science, such as we are now inaugurating, is admirable in itself but it is not complete. Its directors are too enlightened men not to see this, and I am sure they will aid in the co-ordination of

your other educational resources. The ultimate effect of this may be that you may evolve a wider and more comprehensive college for higher education." The forecast which Dr. Playfair made on behalf of a far-seeing group of local supporters of the College has happily proved true.

Literary Studies.

The Leeds local committee of the Cambridge Local Lectures Syndicate (University Extension), wishing to put its work on a more permanent and systematic footing, determined to hand it over to the Yorkshire College of Science. Largely on financial grounds, the college authorities hesitated to undertake this new responsibility. But the small and very distinguished group of scientific professors had been led to the conclusion that the enlargement of the curriculum of the college so as to include literary studies would promote the general usefulness of their work. A demand for teaching in arts came also from the students themselves. Therefore, when the University Extension Committee undertook to guarantee for a number of years the funds needed for carrying on its courses as part of the permanent organization of the College, the authorities found themselves in a position to assent to what was proposed. Consequently, in 1877 a Faculty of Arts was established as an integral part of the organization of the College, the name of which was changed in the following year from the Yorkshire College of Science to the Yorkshire College. Thus, broadened in its curriculum and strengthened by its union with the Leeds School of Medicine in 1884, the College was admitted in 1887 as a constitutent of the Victoria University, the other members of which were Owens College, Manchester, and University College, Liverpool.

From this date onwards the Yorkshire College enjoyed university status. When, however, in 1900, through the efforts of Mr. Chamberlain, a charter was granted establishing the University of Birmingham, the idea of a unitary university bearing the name of a great city appealed to many members of the federal Victoria University. It was felt, especially in Liverpool, that the latter's federal constitution had begun to hamper the growth of the constituent colleges. After long discussions, in which the Yorkshire College took a conservative view, the federal university was broken up and separate charters were granted in 1903 to Manchester and Liverpool. In the following year the Yorkshire College received its Charter as the University of Leeds.

When the College began, in 1874, it had only three departments—mathematics and experimental physics; chemistry; and geology and mining. A department of textile industries was added almost immediately. Twenty-one departments have been established since 1875.

The full-time teaching staff, the third largest in the modern English universities, is 219. Only one modern English university has a larger proportion of staff to students. In Leeds, the proportion is 1 to 6.3, or 7.4 if only the five main categories of teachers are taken. The number of full-time students is 1,385. Of these 378 are women. The proportion of women to men students, 27.3, is the smallest in any of the modern English universities, but in the total number of its women students Leeds is sixth out of the nine. Of the 1,385 men and women students, 959 (69 per cent) have their homes within thirty miles of Leeds. The corresponding figures in the cases of Manchester and Liverpool are 72 per cent and 68 per cent. At Leeds 366 students have their homes within the City itself, 366 in the West Riding county area, 55 in the North Riding, 24 in the East Riding, 92 in Bradford, and 175 in the other county boroughs of Yorkshire. The percentage of students coming to Leeds from other parts of Great Britain is 23 per cent, the corresponding figures of Manchester and Liverpool being 24 per cent and 25 per cent. At Leeds there are 97 students (6.9 per cent) from Overseas. The corresponding figure at Manchester, including the School of Technology, is 6 per cent, and at Liverpool 6.3 per cent. On admission in 1928-9, 86 per cent of the Leeds students were over eighteen years of age, and nearly a half of the total number were over nineteen.

Resident Students.

Among the nine modern English universities, Leeds is fourth in the percentage of its students who are in colleges or in halls of residence. There are five halls of residence in Leeds under University managment, and one under the direction of the Community of the Resurrection, Mirfield. Of the four halls of residence for women, two are in the immediate neighbourhood of the University, and two on the University estate in Far Headingley. The University Hostel for men, Devonshire Hall, has recently been rebuilt on a new site in Headingley, and now accommodates 140 students, with plans for extension to 250 if thought desirable. Some of the halls of residence in Leeds are among the most attractive of those attached to a modern university.

Corporate life is strong and friendly. Music plays a distinctive part in it. The athletic fields are very large. The vigorous University societies promote discussion. The public-spirited officers of the Union

Aerofilms.

THE UNIVERSITY OF LEEDS FROM THE AIR.

carry a heavy weight of responsibility. In view of the onerous duties imposed upon its President and Honorary Secretary during their year of office, the University allows them to take two years over a course of study pursued normally in one year, without payment of more than one year's fees.

It may be asked what are the salient characteristics of the service which the University of Leeds has rendered to the national life, and especially to academic experience, apart from its eminent contributions to learning and literature and to science pure and applied —a list of remarkable variety and importance. First should be named its vindication, largely due to Professor Arthur Smithells, of the claims of technology, if studied in intimate connexion with pure science, to a place equal to that of other disciplines in the University curriculum. Together with mathematics, physics, chemistry, and other forms of pure science, the science underlying the leather industries, dyeing, textiles, coal gas and fuel, not to speak of engineering, mining, and agriculture, has received full recognition at Leeds. Experience has justified this enlargement of the idea of a university. But although Leeds has been hospitable to technology from the first, it has not become a predominantly technological institution. Of its students, 214 are in the faculty of technology, including agriculture, or 15.4 of the whole number. The corresponding percentage at Manchester, including the College of Technology, is 22.7, or, if the College of Technology be excluded, 16.8. At Birmingham University the percentage is 32 and at Liverpool 34.7. At Leeds, the students of Pure Science, Medicine, and Technology are in the aggregate of 59.4 of the whole number. Arts is much the largest single faculty —Leeds 562 (40.6 per cent), Liverpool 639 (40 per cent), Manchester 918 (44.8 per cent), and Birmingham 633 (46 per cent).

The Lay Element.

Secondly, Leeds has made a strong point of blending in University business the experience of laymen with the special knowledge of the academic staff. The Advisory Committees, of which there are twenty-two, including nearly four hundred names, are appointed by the Council under Charter. Some of these Committees are domestic, but all combine the lay and academic elements in their membership. On the Court and Council, the faculties are effectively represented, but the lay members are in a predominant majority. It may be felt that there are dangers in this constitution. But in Leeds, although it took many years to adjust conflicting points of view, a good tradition of temperate counsel has been established. Both laymen and academic representatives feel that they gain from interchange of view and experience. Perhaps it is due to this thoughtfully developed method of co-operation that Leeds University has the habit of planning with extreme care, and after full duscussion in Court and Senate—the latter being exclusively academic—the future course of policy to be followed by the University as a whole, and then of carrying this policy gradually into effect without vacillation or public dispute.

Generous Friends.

This cohesion of the lay and academic elements in University business is reflected in the support given to Leeds University by the public and by the local authorities of the region which it principally serves. Its present buildings and estate, now valued at nearly a million pounds, have been paid for, as regards about three-quarters of the cost, by gifts from those resident in Yorkshire or connected with it. The Clothworkers' Company, the most generous of the friends of the University, have no doubt been encouraged in their munificence by the strong interest which the citizens of Yorkshire and its textile industry have always taken in the University's work.

The fund for the new buildings, which last July had already reached £423,000, is another sign of the readiness of the public to respond to a clear statement of the University's needs. With corresponding liberality the local authorities, pre-eminently the City of Leeds and the West Riding County Council, contribute to its annual income, which in 1928-9 was £230,181, the largest but two among those of the modern English universities. Of this income the percentage of grants from Local Authorities (£56,522, in addition to £27,529 for services rendered) is 24.6, one of the largest of those shown under this head in the list of British institutions of university rank.

Thus, if we include all payments from local authorities, the income of Leeds University rests on three, fairly equal, supports : endowments, donations, and fees, 32.1 per cent ; grants and payments from local authorities, 36.6 per cent ; and Parliamentary grants, 33.1 per cent. From the Treasury grants, now indispensable to the University's efficiency but not forthcoming during two first anxious decades of her growth, Leeds received during the quinquennium 1924-9 £239,000. On the reallocation in 1930, it was intimated to the University that the annual grant would be raised from £61,000 to £71,000, with a non-recurrent grant of £2,000 for the urgent needs of the Library.

Those who know Leeds will forgive the writer many omissions due to lack of space. Only brief reference

can be made to the relations of the University with the Leeds Infirmary, the Leeds Philosophical and Literary Society which publishes papers of scientific and literary research, the Miners' Welfare Fund, and the Dental Board of Great Britain, the Department of Scientific and Industrial Research, the British Silk Research Association, the British Research Association for the Woollen and Worsted Industries, and for some years with the National Benzole Research Association; or to the wide range of the Agricultural Department's work and its close connexion with the County Councils; or to the lectures on Railway Economics, Operating Geography and Law, given in co-operation with Armstrong College to the clerical staff of the L.N.E.R. at York, Hull, Newcastle, Darlington and Leeds; or to the tutorial classes (forty-six) and extension courses (thirteen) held in many parts of Yorkshire; or to the work in Icelandic studies marked by the recent acquisition of the best collection of Icelandic literature in the country outside the British Museum; or to Mr. Montague Burton's recent endowment of a Chair of Industrial Relations.

But it is to memories of the men and women whose personalities have coloured and enriched the life of the University that the thoughts of all who love Leeds will turn as they review its history and try to divine the secret of its strength. The University of Leeds owes most to those who have faithfully and bravely served her. Some of the names to which remembrance is due, including that of Arthur Smithells, have already been mentioned in this article. But in this brief survey space does not, unfortunately, permit the individual commemoration by name of all those who have served the University during the fifty-six years of its history.

Cornish Gardens: A Glory of the Past.

By A. C. Seward, Sc.D., F.R.S.

Professor of Botany in the University of Cambridge.

In this article the author traces in outline the changing scenes in the plant-world from a period many millions of years ago, and speaks of trees cultivated in Cornish gardens as aids to the reconstruction of the past.

THE latter part of this title, borrowed from the late Poet Laureate's *Testament of Beauty*, aptly expresses thoughts suggested to a student of the past history of the British flora by many of the plants which are now cultivated in the gardens of Cornwall and in other of the more favoured counties of the British Isles. A recently published book* contains a long list of cultivated plants; the names of many of them serve as links with the past, and carry us back through thousands or even millions of years to a stage in the history of the plant-world when the vegetation of southern England and central Europe was very different from that of the present day.

In Cornwall, it is possible to cultivate in the open many trees and shrubs which in most parts of England can be kept alive only under glass. The Cornish winters are the mildest in Great Britain: the mean average range of temperature at Falmouth for the winter months is only about 5°F. below that at Cannes and Mentone, and in January it is as warm at Penzance as at Madrid, Florence, and Constantinople. On 13th February, 1929, the maximum temperature recorded at Penzance was 57.5°; at Kew Gardens, 26.5°. On 12th February it was 53.5° at Penzance and 27.5° at Kew. The minimum temperature at Penzance on 11th February was 40°, and at Kew it was 24.5°; for 15th February the records are, Penzance 32.6°, Kew 9°. These figures are taken from Mr. Thurston's book. The connexion between the Cornish gardens and the former vegetation of England may be stated in a few words. The British flora, indeed the flora of Europe as a whole, is now much inferior to the floras of North America and the Far East in the number and variety of plants. Trees and shrubs cultivated in Cornwall and other counties, where the mean temperature is higher than in most districts, enable us to form some idea of the glory of the British flora in its halcyon days. The inferiority of our flora is undoubtedly due in the main to the disastrous effects of the Glacial period, when arctic conditions prevailed over many thousand square miles of Europe where the climate is now temperate; it is due also to the fact that, in the European regions there were more effective barriers to plant-migration than in the New World and in China.

Before attempting a brief summary of the successive phases in the history of the plant-world preceding the Glacial period, it will be helpful to refer to the names

**British and Foreign Trees and Shrubs in Cornwall.* By Edgar Thurston. (Cambridge University Press. 12s. 6d.).

used by the geologists for the stages included in this retrospect :

QUATERNARY PERIOD.		The period in which we are now living. Post-glacial peat-beds, river gravels, etc. Boulder clay, glacial sands, clays and gravels. Arctic plant-beds.
TERTIARY PERIOD.	*Pliocene.*	The Cromer Forest bed : Cromerian flora. Plant-beds of the old delta of the Rhine on the Dutch-Prussian border : (I) The Teglian flora. (II) The Reuverian flora.
	Miocene.	Not represented in Britain.
	Obligocene.	Plant-beds of Bembridge, Isle of Wight, and plants from Bovey Tracey, Devonshire.
	Eocene.	Plant-beds at Hordle and elsewhere on the Hampshire coast ; at Alum Bay, Isle of Wight, and plants from the London clay.

We will first glance at the vegetation of southern England in the earlier part of the Tertiary period, which began many millions of years ago. The British flora was then sub-tropical in character. It included the fern *Acrostichum*, which is now abundant in the estuaries of tropical rivers ; conifers such as *Sequoia*, with its two living species, the mammoth tree and redwood, restricted to a comparatively small area in California, and others known in western Europe only as cultivated trees ; the stemless palm *Nipa*, now characteristic of tropical swamps ; flowering plants such as *Cinnamomum*, including the Camphor and Cinnamon trees, a south-eastern Asiatic genus ; *Catalpa*, an American and Asiatic genus ; *Brasenia*, nearly related to our water lilies, but no longer European ; *Menispermum*, a North American and Eastern Asiatic tree ; *Zanthoxylon*, another American and Eastern genus ; *Diospyros*, including the North American and Chinese Persimmon, and other species. These are only a very few of the genera which were once British, and are now, for the most part, members of North American and Far Eastern floras. Turning to a younger Tertiary flora, an Oligocene flora, described a few years ago by Mrs. Reid and Miss Chandler from the Isle of Wight, an analysis shows that 68 per cent of the plants which are well enough preserved to be identified and were obtained from the sediments of an old estuary, are no longer European but are all either closely allied to or identical with species in North America or China. The climate was probably still sub-tropical, or at least south temperate. It is interesting to note that the conifers included a species of *Libocedrus*, allied to the Incense cedar of California, and a species that now grows in China, also a cypress and an *Araucaria*. The latter genus is now unknown in the northern hemisphere except in cultivation. Among flowering plants were a few genera which still live in Europe, such as a species of oak, a beech, and a hornbeam, but the majority are Chinese and others have their nearest allies in North America and other extra-European countries. Enough has been said in support of the statement that in the early days of the Tertiary period the vegetation of this country was very different from that of the present day ; it consisted in large measure of plants which now flourish on the mountains of western China and others that are North American. As we pass from the earlier to the later Tertiary floras, two important facts are revealed : the successive floras indicate a gradual change from a sub-tropical to a cooler climate, and the proportion of plants that are characteristic of the Far East becomes less. In the list of trees and shrubs in Cornish gardens there are several genera reminiscent of the early Tertiary floras ; *Araucaria excelsa* (Norfolk Island pine) closely allied to a species recorded from the Oligocene flora of the Isle of Wight ; *Cryptomeria japonica*, the Japanese cedar ; the Maiden Hair tree, *Ginkgo biloba*, now unknown in a wild state but widely spread in Europe and in other parts of the world through the greater part of the Tertiary period ; *Taxodium*, the swamp cypress of eastern North America, and *Glyptostrobus*, a related conifer that is now confined in China.

Natives Restored.

Among the cultivated broad-leaved trees once native to Britain are *Catalpa*, a species of *Cinnamomum*, allied to the camphor tree of China and Japan, the hickory (*Carya*) of North America ; the tulip tree (*Liriodendron*) confined to North America and China and a member both of the older and younger Tertiary floras of Europe ; *Magnolia*, now American and Asiatic. These and many other trees and shrubs which grow out of doors in Cornwall and some other parts of England, though they are described as introductions from foreign lands are, in fact, genera which were once European, natives restored after a long absence. They are plants which were driven out of western Europe by natural causes, and in recent years, after long banishment, some of them have been brought back by man.

When we follow the history of the plant-world in western Europe into the Pliocene stage of the Tertiary

period, and scrutinize the lists compiled from fossils collected in the old delta of the Rhine at Reuver and Tegelen, we find a marked falling-off in Chinese species and a gradual approximation to the present character of the vegetation. This change was accompanied by, and was, indeed, a direct consequence of, a gradual lowering of temperature. The Reuverian, or older Pliocene, flora still included many genera that are now native in China or North America but extinct in Europe : 54 per cent of the plants which have been satisfactorily determined from their fossil fruits or seeds are North American or Chinese. A comparison of this flora with the later Teglian flora shows that the percentage of the foreign plants had fallen to 16 per cent.

Fossil plants present in the sediments of the eastern edge of the ancient delta of the Rhine, which formerly stretched across the area that is now covered by the North Sea, enable us partially to restore the vegetation and climate at the end of the Tertiary period. The Cromerian flora is practically the same as that in East Anglia to-day, and this points to similar climatic conditions. It is clear that during the successive stages of the Tertiary period the vegetation of Britain was progressively impoverished : the earlier floras were rich in Chinese and North American plants and genera that still occur in Europe were relatively few. As time went on, the climate became cooler and the vegetation gradually assumed its present character. The beds from which the remains of the Cromerian flora were collected are followed by a still more recent plant-bed containing fragments of an arctic willow (*Salix polaris*), which now grows in Spitsbergen, and the dwarf birch (*Betula nana*). Here is the beginning of the Quaternary period, a phase foreshadowing still greater changes caused by a reign of ice. Above the arctic plant-bed are thick masses of boulder clay and other legacies from the glacial period, which demonstrate the extension of enormous sheets of ice from the highlands of Scandinavia and the Scottish hills over the greater part of Britain and across the German plain. What, it may be asked, was the effect upon the contemporary vegetation of this climax? Some of the hardier plants almost certainly lived through the glacial period on a few mountain tops and ridges of high ground which were not completely overridden by ice, but the greater part of the vegetation was either destroyed or driven far to the south. Our chief concern is with the European vegetation as a whole : as the sub-tropical and south temperate

[*Reproduced from "British and Foreign Trees and Shrubs in Cornwall."*

A CLUMP OF HARDY BAMBOOS IN A CORNISH GARDEN.

climates of the Eocene and Oligocene stages gradually changed into the cooler climate of the early Pliocene, and the still cooler climate of the last phase of the Tertiary period, many genera of trees and shrubs, including those previously mentioned as Far Eastern and North American, were compelled to seek warmer stations and slowly travelled towards the south. But as the mantel of ice increased in size and covered a larger area, the migrating plants were driven to regions farther afield. When the Ice Age reached its maximum, the travellers found their way to safety barred by the Alpine chain, and beyond that by the Mediterranean Sea. The country north of these obstacles did not afford the shelter that was needed, and, as routes to warmer lands were blocked, extinction followed.

We may picture a fairly uniform and far flung vegetation in the ages before the Glacial period, occupying a vast area over the northern hemisphere and reaching north of the arctic circle : as the climate became increasingly severe such plants as were able, by means of natural agencies, to seek new homes, wandered to the south along divergent routes, some down the American continent, others along open roads in Europe, and others through the valleys of Eastern Asia. Of these migrants, some travelled a comparatively short distance and were eventually able to regain their temporarily deserted homes as the Glacial period waned : they were the hardier plants and such as now live in Britain. On the other hand, the more delicate members of the pre-glacial flora were compelled to take longer journeys. In North America and the Far East they were able to reach safety ; no transverse mountain ranges and no barrier of sea lay in their path. The refugees in the middle or European region were less fortunate : those which failed to establish themselves in central Europe, being cut off from the lands beyond the Alps and the Mediterranean, fell victims to the unfavourable conditions. Thus it is that the British and European floras are much poorer in genera and species than those of the New World and China : their glory has departed.

Causes of Impoverishment.

A word of caution must be added : while climatic change has been the most influential factor in the impoverishment of the British flora, other factors have played a part. The fact that sub-tropical trees are able to grow in the open in the south-west corner of England serves as an illustration both of the adaptability of plants to an environment less favourable climatically than that in which they live in a wild state, and of the danger of presuming to estimate within narrow limits the temperature of former periods from a comparison of fossil and recent plants. The foregoing sketch, incomplete though it is, may serve to supplement the attractiveness of many of our foreign trees and shrubs by calling attention to their historical interest. Venerable trees, it has been said, like most other ancient people, " are always dreaming out their old stories to the winds "—

> " While visions, as poetic eyes avow,
> Cling to each leaf and swarm on every bough."

A little knowledge of the past helps us to enter into the spirit of their dreams.

Scientific Research in America.

An important programme of new work in various branches of scientific research is outlined in the Year Book of the Carnegie Institution of Washington, which has just been published. In the programme of the Mount Wilson Observatory the possibility is discussed of extending the study of the spectrum of stars into the regions of the ultra-violet, where research has not yet been possible. A study of the intensity of lines in the spectrum of the sun is also contemplated, but further developments await the completion of suitable apparatus.

Attention will be given to the successful refinement of photographic emulsions to permit accurate recording of more delicate visual elements than can at present be obtained from photographic plates. The limit of observation of remote bodies in space is determined by the character of light impressions. If the amount of light received for a given moment of observation is small, multiplication of the time or refinement of the photographic plate may make it possible for the telescope and the photographic apparatus to make a record which would otherwise be unattainable. Concentrated attention upon the development of this type of apparatus might considerably increase the opportunities for astronomical study.

Research in terrestial magnetism is somewhat hampered at present by lack of equipment. This department, however, has recommended the installation at its station in Peru of seismological apparatus for obtaining information concerning both local and distant earthquakes in the Southern Hemisphere.

Investigations in the newly established Division of Historical Research have effectively been carried out during the past year, and further developments are contemplated. Early American history is being studied, and the relation of the so-called Archaic culture of Middle America to the typical Maya civilization is being investigated.

Some Problems of Gull Life.

By F. B. Kirkman, B.A.

The black-headed gull is familiar to most bird lovers, but little is known about its remarkable activities during the month which precedes nesting. This period is here described and is illustrated by the only photographs published of the hen bird begging for food. The photographs are the author's copyright.

In the middle of Norfolk, some forty miles from the sea at Yarmouth, there is a famous sheet of water known as Scoulton Mere.* It is hidden among tall trees and bordered here and there by groves of rhododendrons. For nearly the whole of its length stretches an island which is covered by a thick growth of alder and birch, except at one end where there is a bare tongue-shaped space of tussocky swamp, over two hundred yards across at the base. This space is known locally as the Hearth. It is visited each year by thousands of black-headed gulls, the little red-legged, red-beaked sea birds so familiar to Londoners as winter visitors to the metropolitan parks and river-side.

The black-headed gulls pay their first visit to the Hearth in mid-March. They continue to make daily visits until the middle of April, when the first nests are built and continuous occupation begins. It is the little known but eventful period of daily visits that is here described. The subsequent period of domestic activities from mid-April to July is more or less familiar to thousands of people who visit gulleries either inland or by the sea. These activities follow a regular routine : nest-building, incubation and care of young. Whether a common routine is followed in the mid-March to mid-April period of daily visits is not yet known. What is here said must be taken to relate only to the great gullery at Scoulton.

Unusual Shyness.

The first fact impressed upon one during this period, notably during the earlier days of it, is the extraordinary shyness of the birds, so unlike their usual behaviour. The appearance of anybody on the bank opposite the gullery is enough, in spite of about a hundred yards of intervening water, to put them to flight. Of this I had bitter experience one year, on the day of their first visit on 19th March, a late date. They came into the Mere during the night. Long before dawn their loud unceasing clamour could be heard, and I arrived to find the Hearth thickly spotted white with the birds, while hundreds circled above it in the mist, or floated on the water. Hardly had I crawled into my hide when a sudden and complete cessation of noise told me, even before I turned to look, that an incautious movement on my companion's part had set the whole colony on the wing. It swept upward in a broad silent white stream to break once more into clamour only when in mid-air. All we saw of it for the rest of that day was an occasional flock drifting miles away, high over the countryside.

*Pronounced Scowton.

Nervous Upflights.

During the next few days, the birds continued in a state of extreme nervousness. General panic-stricken upflights took place every quarter of an hour until the final departure in the afternoon. In most cases, several birds, less nervous than the great majority, remained on the ground, a sure sign that the rest would be back in a few minutes. If all left the Hearth, an absence of an hour or two was usual. Only gradually as the days passed did the upflights become infrequent.

The silence of the upflights already noted was preceded sometimes by a few moments of silence during which, on every part of the Hearth, the thousands of birds stood motionless, their necks drawn up, their feathers compressed, their muscles set tense for instantaneous release. During these few moments one could feel rather than see the united scrutiny of countless small eyes concentrated upon one's creeping or crouching form. Then, without transition, followed the massed upward rush. The description is true of upflights made at any later period of the season, when the gulls are disturbed, but these are local, occurring only in the disturbed area, and the hush which accompanies them, though it makes itself felt, is also local. They are insignificant when compared with the upflights of the earlier period, when the vast clamour, rising incessantly from the whole gullery, is cut short instantaneously.

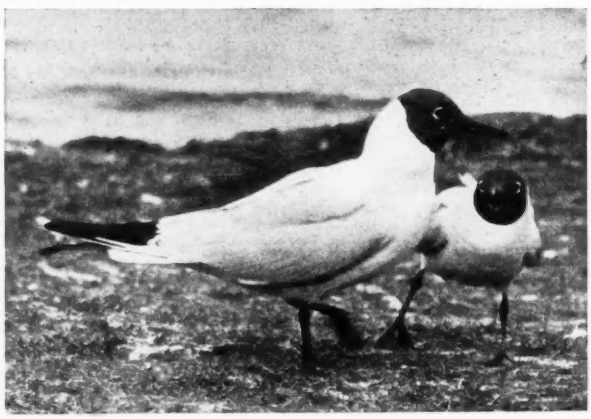
The return to the gullery, far from being silent, is accompanied by a frenzied outburst of noise. A description of one of the descents may stand for all, it being understood that, though each resembled the

others in general, no two were alike in detail. This descent took place as late as 16th April, after an upflight of the whole flock and an absence from the Hearth of about three-quarters of an hour, during which the birds were at times almost out of sight.

The first sign of the return was the massing of many thousands above the gullery, but at a considerable height. The mass swung in a gradual descent till it formed, just over the Hearth, an immense tossing snow-white canopy of shrieking birds. From it there dropped scattered individuals that kept flying not more than a few yards above the ground. One of them alighted : for a few moments it stood a solitary little figure upon the wide bare space, until scared by its isolation it took wing and was gathered into the whirling throng overhead. Another alighted, a second, a third, a fourth, and then came a storm of hovering, descending, alighting gulls, their white wings glancing, their red legs flashing, their red mouths filled with sound and fury. Every bird seemed in a state of uncontrollable excitement. Those in the air made vicious pecks at the backs of those on the ground, while the latter stood, necks upstretched, in every attitude of wide-beaked resentment. Gradually the noise and movement subsided. A few minutes later, there was a sudden hush ; the birds were on the wing and streaming upwards. But it was a false alarm, or an after effect of the previous alarm, for many remained on the ground. A few minutes later, the descent began, to end as before and always, in the final fierce frenzy.

The shyness of the birds during the March-April period is in strong contrast to their behaviour after the eggs are laid. Then, they still react locally by silent upflights to any alarming object, but they are soon back, and those near whose nests the intruder happens to be swoop one after another to within a foot or so of his head, there to vent their feelings in ear-splitting screams before swerving upward to turn and renew the assault. While the aggressive boldness of the species in this later period is what one would expect, its shyness in the earlier period calls, perhaps, for an explanation. Why should the birds rise in panic at the first sight of anyone near a carefully protected gullery surrounded by water, when on the very same day, in the fields outside the gullery, they do not hesitate to follow close upon the heels of a man behind a plough ? A possible answer, though difficult to prove, is that individuals of a gregarious species may react instinctively in much the same way as individuals of a non-gregarious species. Thus, just as a robin, confiding in the winter, becomes shy and furtive when the time for nest-building approaches, so also the gregarious gull may become shy, but with differences due to the fact that it is acting as one of a flock.

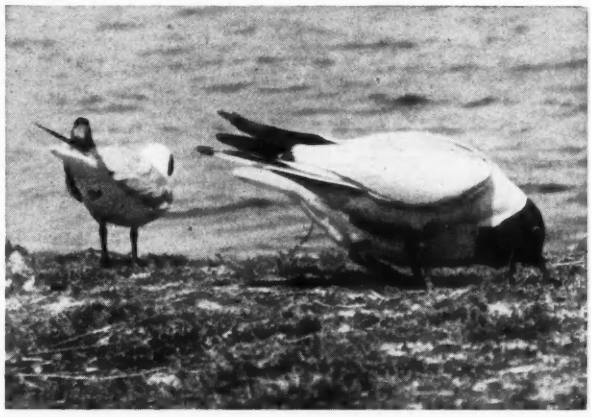
During the entire period with which we are dealing, that is, from the day of arrival in March to the building of the first nests in mid-April, the whole colony leave the gullery every evening to return during the night. Where the birds go I was unable to discover. The general impression in the neighbourhood is that they seek a roosting place somewhere inland. This is probably correct, for the evening outflights are always in a south-westerly direction, that is, inland towards Ely and Cambridge, and not, as one might expect, towards the sea. During a visit which I paid in March, I was able to form no definite opinion as to the direction taken, for after the first day, the gulls rose in a mass from the Hearth, usually at about 4.30 p.m., and from then till sunset scattered flocks were to be seen flying in all quarters. But I was assured that they went south-west. That they did so in April I had no difficulty in discovering for myself. These later outflights differed from those in March, the birds going at sunset direct to the roost from the gullery. The following is an account of the first I witnessed.



THE HEN BEGS FOR FOOD—
The feeding habits of the black-head are interesting. The male swallows the food and carries it to the hen, but it is not always passed on without considerable persuasion.

I was in the cottage where I lodged, when, at about seven o'clock in the evening, I heard the familiar notes of the blackhead, uttered not by the single birds or small companies that at all hours of the day passed to and fro between the gullery and the fields, but by an increasing multitude. On going out, I saw a thick white cascade of gulls pouring down through

an opening in the tops of the trees between myself and the lake. Before reaching the ground, they turned forward and flowed in an undulating line, hundreds of yards long, through the orchard, behind the cottage, across the fields and over a ridge into the south-west. For many minutes this living stream, in parts no more than a few scattered birds, in parts close flocks of many scores, in all some thousands, continued to pour noisily out from the Mere; then it came to an end, and a minute or so later the last receding birds vanished.



—WITH THE DESIRED RESULT.
The cock bird is prevailed upon to disgorge. This and the previous illustration are the only photographs of this subject published, and are the author's copyright.

No sooner had the flock disappeared than there suddenly dropped through the break in the tree-tops, not the first columns of another great host, but an isolated pack of nine. The diminutive band, making up for lack of numbers by noise, passed cheerfully chattering across the orchard, over field and hedgegrow into the west. After an interval, separate packs came in quick rushes through the same gap; they swept down, and filed past with incessant clamour as they went. During their passage, I saw high up a large flock that had returned in a hesitating mood; for a time it hung in the sky before being moved to take its former course. Another interval passed, and again there appeared a procession of detached packs, which made a long broken line from Mere to hill. When they had gone, I moved to where I could gain a view of the Hearth, and found that it was still alive with gulls. Their white forms dotted its surface, or made spectral circles above it in the twilight, while close over the dead blackness of the water snow-white screaming bands raced in an ecstasy of unrest. From these late flocks there parted an upward-streaming mass; it burst over the tree-tops and swept in a vast drift across the orchard and fields towards and over the ridge. It was followed by a succession of small separate flocks. After a final interval, the outflight ended with one unbroken line that passed through the growing dusk in huge rolling curves of flickering white. Its thousands of birds flew in haste; the last of them crossed the ridge, became for a moment spots which danced in the after-glow, and were gone.

This magnificent procession was not less than half an hour in going past. Many thousands of birds took part in it. I witnessed it again on the three following evenings, and found that its general features remained the same—the long white undulating lines of flocks, the almost musical accompaniment of many-toned and joyous cries, a march played by an ever-changing orchestra of thousands, the restless excitement in the deepening shadows of the Mere, and the final quick-winged bands. But each evening the details of the pageant differed. On the second, for instance, there was a quick uprise from the Hearth of hundreds of birds during the first half of the period of exodus. These refused the customary track, and, after sweeping the surface of the water in a lightning rush, flew over the trees at a point further down the lake, and passed in a riotous horde across the fields in front of the cottage, while behind it at the same time the main stream poured steadily onward.

Of the return to the Hearth, there was little to be seen, owing to the darkness, except now and then dim forms flitting overhead, or a serried mass of tiny black dots passing high across the face of the moon-lit clouds. But if the birds were seldom visible, their outcry filled the sky, and even in the wildest weather it could be heard between the gusts, descending in broken ripples of sound from the gale-driven hosts. These nightly absences grew shorter as the days passed. In March, the colony left the Hearth as early as 4.30 p.m., and returned after midnight, being absent about *eight* hours; in April they left as late as 7 p.m., to return before midnight, being absent about *four* hours. Thus as the time for nest-building and egg-laying approached, the urge of the roost became weaker and that of the Hearth stronger. As soon as the eggs appeared in the nests, the urge of the roost ceased. Thence onward, until the date of departure in July, the breeding pairs were in continuous occupation of the Hearth day and night.

What made the great outflights more remarkable still was the fact that they were not confined to the breeding birds. Each evening there arrived in the

gullery a number of immature blackheads, easily recognized by the brown tail rim and the brown on the wing coverts. Very few were present in the morning, and these were no doubt breeding birds, for, as I discovered at a later date in another gullery, birds in third summer plumage may frequently be seen with eggs and chicks. A number of non-breeding adults probably came each evening with the immature birds. This I inferred from the fact that the gulls on the Mere were three to four times as numerous in the evening as during the rest of the day. The increase was in part due to the presence of many mated birds absent at intervals during the day in search of food, but if to these be added the relatively small number of immature birds, there remained a large balance to account for, and they can be accounted for in no other way.

The movements of these non-breeding birds, immature and adult, is difficult to explain. One can understand that the breeding impulses working in them, if any, were not strong enough to draw them to the gullery in the day time, but why did they go there in the evening rather than direct to the accustomed roost somewhere in the fields? The possibility is that when evening came, and with it the impulse to go roostward, each non-breeding bird followed the breeding birds with which it happened to be feeding. This does not exclude the further possibility that some of the non-breeding birds did go direct to the field roost and not in the first place with their fellows to the Mere. It is the field roost end of the proceedings that requires investigation.

A Memorable Sight.

The enormous increase in the number of birds in the Mere towards dusk made a picture to be remembered. The Hearth seemed for the most part to be covered with living snow. Now and again a part of this covering would rise in a silent white drift that a minute later became a vociferous downpour of fluttering wings. In the air, individual birds could be seen at any moment flitting to alight on the Hearth or the water, while here and there a bird in quarrelsome humour made lightning upflights on outstretched wings, the better to pour invective upon a neighbour, which, in turn, screamed invective back as it hung suspended in mid-air. On the lake, hundreds floated, bathed, bickered, while close over its surface swept shrieking bands, the vanguard perhaps of the coming out-flight, that with a sudden dip would break the water into foam, and rising drive onward in tempestuous flight. In strong contrast to this noise and movement was the peace of the setting : a ring of silent trees, a still lake, the music of woodland birds, the distant tapping of a woodpecker's beak on hollow timber, the heron in the shallows, its long legs rooted in the mud. The gulls, alien, intrusive, brought into the setting the restlessness of the sea.

Daily Behaviour.

The account of the colony during the period from mid-March to mid-April would be incomplete without some reference to the daily life on the Hearth itself. Owing to the intervening water I was unable to watch this as closely as I could have wished. But one fact was clear enough : the birds came paired to the Hearth, and each pair had its station, a small patch of ground which one or the other bird might leave from time to time in order to exercise its wings, visit the water or leave the gullery for food, but to which sooner or later it returned. There was a certain amount of bickering between neighbouring pairs, but not of a serious nature. If individual birds occasionally trespassed, it was due to the accident of alighting on ground outside their own stations. When driven off, they went with obliging promptitude. I saw no attempt on the part of one pair to dispossess another. The fact is worth noting in view of the fights for " territories " recorded of other gregarious species.

The number of birds on the Hearth during the day was relatively small ; they were chiefly hens. The males were kept busy flying out of the gullery into the fields for food. To be convinced of this, one had only to keep one's glass fixed on a returning bird. This bird alights by another bird, his mate. At first sight, his behaviour would lead no one to suppose that his recent excursion had importance for anyone but himself. He stands and looks about. But on closer scrutiny one notes that he has an air of being expected to do something, which must be done sooner or later, the later the better, apparently, for him, the sooner the better for his mate. She sidles up to him in a suppliant posture, her body sometimes almost crouching, in strong contrast to his, which is erect ; she utters an insistent begging note, often with retracted neck and with quick upward jerks of the beak which resemble incipient swallowing movements. Her approaches are so far from being well received by the cock that he moves a step or two away. The hen follows every movement ; she becomes more insistent, presses upon him, makes nibbling pecks at his neck, his throat, his beak, even at the top of his head ; she gives him no peace. At last he makes an effort, or seems disposed to do so ; he lowers his beak to the ground and opens it wide, but at the same time obviously swallows something

that was on its way up. He once more looks about him uncomfortably, as if waiting upon the issue of internal happenings. The insistent pressure recommences; another effort is made with the same result; more urgent pressure is brought to bear, and, after a final effort, the bird's head bends down and from his wide distended beak falls a packet of semi-digested worms and insects. A second or two later the cock bird is probably feeding by her side.

If watched again and again, this interesting performance will, of course, be found to vary. But all its forms may here be ranged in two categories. The first is marked by the reluctance or inability of the cock bird to react, and the second is by his readiness to deliver whether his mate begs or is too indifferent to make a movement even when the food is presented to her. I noted a singular instance of this at another gullery, and at a later date, 26th May. Without any begging movements on the part of the hen, the male produced and laid on the grass a singular object that I could not identify. It was not unlike a piece of bacon rind and fat about one-quarter of an inch broad and two inches long, the rind black and the rest white. The hen was not to be tempted by this delicacy, whereupon the male swallowed it, but only to disgorge it again; he spread it on the grass with something of the reverential air of a waiter uncovering a culinary masterpiece. But the hen continued unmoved; so the thing was again swallowed, and I was privileged to see it no more.

THE BLACKHEAD'S NEST.

The evidence tends to show that the male bird alone builds the nest, but once it has been built, both sexes continue to add material to it. The cracks in the left-hand egg were made by the chick inside.

The period of daily visits ended on the building of the nests. The first I noted was on 12th April. My attention was drawn to it by the sight of a gull standing by the lake edge and tugging violently at a resistant water-weed, its wings erect and waving to save it from falling on to its tail as it swung forward and backward. Finally it pulled the weed out, flew with it in its beak to the next spot, dropped it, sat on it and stamped it into place with rapid alternate movements of the feet. It may be of interest to add that the bird makes the same movements of the feet every time it settles on to its eggs, and frequently on the mud-flats in winter, as a method of bringing edible organisms to the surface.

During my two April visits to Scoulton, I saw in all twelve nests being built, and in every case by one bird only. I took it for granted that the builder was the hen. I had just recorded the twelfth instance, and was slipping my note-book into my pocket with a satisfied sense of having neatly completed the job, for twelve is a round judicial number. As I was about to quit the gullery to catch my train home—it was the last day of my visit—I came to a sudden halt: the mate of the builder was present and was begging for food. This indisputable evidence left me assured that the birds which begged for food were hens. The hen I saw therefore was not building; the builder was the male. As one bird only was seen building in every case, it is possible that the male alone builds. Evidence collected at later dates in other gulleries tended to fortify this supposition. But against it is the fact which I noted over and over again, that, the nest once built, both sexes continue to add material to it. Why should one sex build the nest and both add to it when built? The question remains an open one.

The adding of material to the nest continues after the eggs are laid and soon after the chicks are hatched. The extent to which addition proceeds varies greatly from bird to bird. In the case of some it amounts to a mania. The result is enormous nests which may rise to over a foot in height, and be composed of material enough to fill a large bucket to overflowing. Such nests serve no useful purpose; that is clear from the fact that the small nests fulfil all the bird's needs.

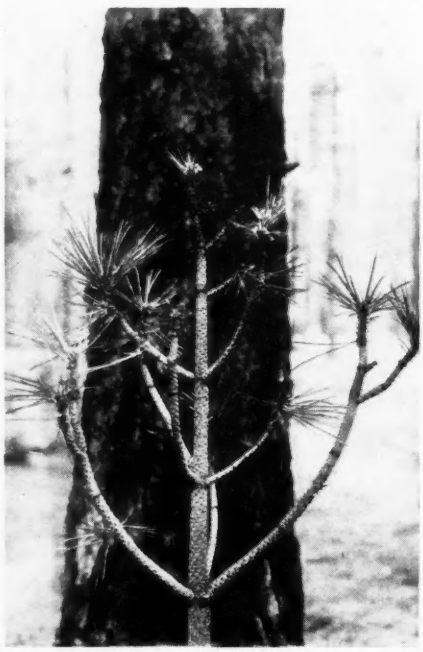
Trailing a Pest.

Infestations of certain insects are a serious menace to the forests of Western America. Efforts are being made to exterminate the pandora moth, which causes incalculable damage to pine trees and has so far eluded control.

WHILE man is gaining the upper hand of many natural forces, he still finds some of the most minute creations difficult to control. Despite what has been achieved, for instance, in restricting mosquitoes and other insects inimical to mankind, fear of overwhelming invasions by certain insects is lively in the minds of those familiar with the capabilities of such pests.

Forests and orchards are not only destroyed by man and animals: tiny caterpillars have shown that they are able, in a very short time, to reduce great woods to leafless, deformed sticks. The depredations of the pandora moth, for instance, are formidable. *Coloradia pandora* Blake, the pandora moth, is one of the greatest enemies of certain forest areas in Western America. During the years from 1918 to 1925, a serious epidemic of this moth occurred in Southern Oregon. The insect attacks only pines, its principal hosts being western yellow pine (*Pinus ponderosa*) and Jeffrey pine (*P. jeffreyi*). Lodgepole pine (*P. murrayana*) is sometimes attacked. Its range is known to cover the Pacific States, and specimens have been collected in Colorado and Montana.

This large moth is regularly present in this region, as well as in many other parts of the West, but the history of its past occurrences in destructive numbers reveals the fact that in Southern Oregon the insects increase to the proportions of an epidemic at regular intervals of about twenty or thirty years, and continue to be abundant for from six to eight years. Under normal conditions, infestations of this moth are of no economic consequence because no appreciable injury is done to the tree. Its epidemic infestations are, however, a serious menace to pine stands. The damage resulting from such infestations is divided into two phases: the primary injury to the tree, which results directly from the loss of needles, and the secondary injury through the impaired vitality of the tree, which renders it susceptible to bark-beetle attack.



COMPLETE DEFOLIATION.

The top of a yellow pine showing almost complete defoliation after the successive biennial feeding of the caterpillars.

Although *Coloradia pandora* at some periods may cause practically complete defoliation of the trees which it attacks, it is not always in itself fatal to its host. This is due to the fact that the terminal buds are not eaten by the larvae and that the trees have a rest every other year; thus the more vigorous specimens survive the defoliations. Economic loss results, however, even though the trees attacked are not killed, because their growth is greatly suppressed during years of heavy defoliation, as shown by a comparison of the width of the annual rings. Losses on the Klamath Indian Reservation from this suppression of growth during the last epidemic have been conservatively estimated at several hundred thousands of dollars.

The width of the annual rings may be as much as eighty per cent less than normal, and in some cases the trees fail to acquire any new wood on one or more sides of the trunk. A great loss of increment occurs during the period of an epidemic, and when sustained over large areas of merchantable timber, it amounts to many hundred thousands of board feet. This loss is known to exist, but complicated factors make it difficult to estimate even roughly the total loss occasioned by such an epidemic. The fact that there is very wide variation in the degree of defoliation of individual trees is the greatest difficulty encountered in this regard. Frequently a completely defoliated tree or group of trees will be found standing

EGGS OF THE PANDORA MOTH.

A cluster of eggs on yellow pine bark. The eggs are deposited on the bark and foliage of the trees and the incubation period is approximately forty days.

side by side with trees only slightly defoliated. The amount of increment loss is entirely dependent upon the degree of defoliation, and the variableness of the latter makes an accurate estimate of the loss over large areas almost impossible.

Some idea of the loss was obtained by making a study of individual trees in areas where the epidemic had occurred, and comparing their rate of growth with that of trees under normal conditions outside defoliated areas. But the study does not date from the beginning of the epidemic, and it is not always possible to determine accurately in what year the trees selected for comparison were first attacked. Despite these difficulties it is considered well within conservative limits to place the loss thus far sustained during the recent epidemic in the Klamath region at not less than several hundred thousand dollars. Although the epidemic infestation has declined, it will be many years before the trees which have suffered severe defoliation regain their normal growth rate, and thus a further loss in increment will be sustained. This will depend upon the rapidity of their recovery, which at this time is merely a matter of conjecture. This type of damage is characteristic of many forest-tree defoliators, especially of the spruce budworm (*Harmologa fumiferana* Clem.), occurring in the northeastern part of North America.

The damage caused by bark-beetle attacks in stands of pine defoliated by the pandora moth has been far greater than the primary damage of the defoliator. Infestations of *Dendroctonus brevicomis* and of *D. monticolae* have shown an abnormal increase in the defoliated areas studied. These infestations were of far greater intensity than were contemporary infestations in stands adjoining the defoliated areas, and beetle attacks upon defoliated trees were always fatal.

Before 1923, the defoliated stands were remarkably free from infestations of the beetle. In that year, however, five years after the pine moth epidemic began, the defoliated stands were invaded by these beetles, and within two years an outbreak of them developed which seriously menaced the entire area. The progress of the outbreak on an area of two thousand acres was as follows: In 1923 the area contained fifty trees infested by beetles, which may be considered a normal infestation in these stands. In 1924 this infestation included in all 391 trees, an increase of 682 per cent. But 506 trees had become infested in 1925, an increase for the year of 29 per cent, and in 1926 a total of 744 trees had been killed, an increase of 47 per cent in the third year. These figures show that in three years the bark-beetle epidemic, which was a secondary result of the defoliations, had increased 1,388 per cent.

The life cycle of the pandora moth covers a period of two years. The adults are brownish gray, with a wind expanse of approximately three inches. They are diurnal, and in epidemic infestations countless numbers are seen on the wing. The eggs are deposited on the bark and foliage of trees and bushes, and

SPRING FEEDING.

Caterpillars (*Coloradia pandora*) in the first spring feeding stage eating yellow pine needles. During this period the insects completely strip the branches.

sometimes on ground litter. The incubation period is approximately forty days. The young larvae feed in colonies upon the needles of the terminal shoots during the first summer, and, when winter sets in, hibernate in clusters at the base of the needles. Feeding is resumed in the following spring, and during the second feeding period large quantities of needles are consumed, and the greatest damage is suffered by the host. Pupation begins in June of the second year and takes place in the ground from one to five inches below the surface. The pupal stage covers one full year, the species passing the second winter as pupae in the ground. The caterpillars are subject to a wilt disease similar in general manifestations to the gipsy-moth wilt. Ground squirrels eat large numbers of the pupae, and birds prey upon the caterpillars. The insect enemies of *Coloradia pandora* are three hymenopterous parasites and one dipteron. A study of the pandora by the Bureau of Entomology, United States Department of Agriculture, has revealed that a relatively high percentage of the eggs are infertile.

The larvae leave the eggs by way of holes gnawed in the ends of the shells, and immediately crawl to the tips of the branches and begin feeding on the needles of the current year's growth. They are gregarious during the first feeding stage; from four to twenty may be found together on the needles at the terminals of the twigs. They attain a length of twenty-three mm. by the end of the first feeding season. When winter conditions set in, which at the altitudes where the species occurs is normally about 20th October, the caterpillars go into hibernation in clusters of from four to thirty individuals. They enter the base of the needles on the ends of the pine branches, and are more or less dormant during the winter. They have not been observed to feed during hibernation, and do not increase in size. With the cessation of winter conditions, usually about 1st April, the caterpillars again become active. The hibernating masses break up and the individuals disperse to some extent and resume feeding.

Spring Feeding.

During the spring feeding period, which lasts until 20th June, the caterpillars consume an enormous quantity of needles and grow rapidly. Feeding is not confined during the spring period to the needles at the tips of the branches, but the caterpillars work back along the stem and consume all the needles of whatever previous year's growth. From about 1st May to the time of pupation they also eat the new needles which unfold from the buds, and make their greatest growth during this period. The terminal buds, however, are not eaten, although the new needles are generally nearly all devoured. Owing to the two-year life cycle of the insect, the wholesale destruction of the new needles at the critical period of the tree's growth occurs only on alternate years, the corresponding time of the intervening years being passed by the moth in the pupal stage.

The prepupal caterpillars are excessive feeders, and consume a large quantity of needles. A batch of thirty-four nearly full-grown caterpillars were kept in a cage from 1st June until 16th June. During this time, they ate an average of seven hundred yellow pine needles every twenty-four hours, or an average per caterpillar of twenty-one needles a day. When full-grown, the caterpillars crawl down the trunks of the trees on which they have been feeding and enter the surface of the soil to pupate.

Correspondence.

"THE ACHAEMENID ART OF PERSIA."

To the Editor of DISCOVERY.

SIR,

I have great respect for Mr. Stanley Casson as an authority on ancient art, but I think that he has tripped up in his article in the February issue, when he writes under the heading "A Great Invention": "One great invention of craftsmanship comes down to us from early Persia, if nothing else, namely the craft of *cloisonn e* and 'encrusted' jewellery . . ."

This method of treating jewellery was known to the Egyptians a thousand years before the time mentioned by Mr. Casson; fine specimens can be seen in any art book on Egypt. In technical detail he may be correct, but broadly I think he is wrong. The accuracy of your journal can usually be relied on, and it seems desirable, therefore, to explain this passage.

Yours faithfully,

Wanborough, Wilts. A. D. PASSMORE.

Mr. Stanley Casson writes:—"Mr. Passmore rightly suggests that *Discovery* maintains a high standard of sound and correct information. I am the more anxious, therefore, to correct his misapprehension. The 'great invention' to which I referred was *cloisonnée* and its immediate prototypes, not stone-inset jewellery as such. So rare and unusual is *cloisonnée* in the history of craftsmanship that since late Roman and mediaeval times only one other nation has ever achieved success in it—the Japanese. That Egyptian jewellers employed the method of insetting stones in goldwork was a fact of which I was fully aware. But the bulk of such Egyptian jewellery, vastly different in character from the Persian, belongs to a period at least a thousand years before the time when the Persians developed it, and few would venture to suggest that the Persians revived a long dormant method. They re-invented it, perhaps. My article was concerned with the historic period of Asiatic and Persian art, not with Egypt or with any prehistoric time. From the point of view of the development of European and near-Asiatic art the Persians certainly produced the prototypes of what later became Gothic, Byzantine and Franco-German *cloisonnée* and *champlevé*."

A Little-known Island of the Pacific.

By W. R. Price, B.A., F.L.S.

The island of Formosa has unexpectedly claimed the public attention, following the recent massacre of Japanese guardsmen by the aboriginal inhabitants. In discussing the Formosans, previous writers have consistently ignored the Indonesians, a small but interesting branch whom our contributor describes.

THE recent trouble between the Japanese and aborigines in Formosa is a reminder of the existence of this interesting and beautiful island, a little known dependency of the Japanese Empire. A study of its history reveals the age-long struggle for existence of the inhabitants, for few small territories can have borne quite so continuous a sequence of invading hordes as those to which Formosa has constantly been subject.

When I returned from the island after a year of plant collecting in the interior, I was glad to feel that, although three-quarters of the savage territory has become civilized, and has been made accessible to the botanist, there still remains a small unknown area in the north into which no one has penetrated. This region of towering mountains, deep valleys and dense forests, reaching from humid sub-tropic levels to rhododendron scrub bordering on snow, retains unspoiled its primeval aspect, its plants and animals, and its aboriginal inhabitants. The owners forbid entrance to their territory for reasons inculcated by hard experience. They are the Taiyals, a fine, warlike race of head-hunters, the only remaining aboriginal tribe of the nine recognized in the island which still retains its independence.

The Japanese have completely surrounded them; hundreds of guardsmen hold a cleared line which runs through dense oak and pine forests for a hundred and fifty miles. This line is held day and night with the help of blockhouses, electric wire fences and battery positions. Periodically, and usually with loss of life on both sides, the line is drawn towards the centre. Within seventeen years, the Japanese skilfully subdued the rest of the island, but as long a period has now elapsed and they have made little further advance into the northern stronghold.

IMPENETRABLE FOREST.

Although the Japanese have subdued most of the island, there is an area in the north which they have been unable to penetrate. River beds afford the only access.

Why is this? True, the Taiyal country, centering on Mount Sylvia, is the most inaccessible of any, but it is only slightly more so than the country in the centre of the island where all is quiet. The real reason why the Taiyals have fared so differently from the other tribes is likely to be found in their own characteristics as a race. The history of aboriginal tribes is a subject of which to be wary, since much conjecture and speculation is inevitably involved, but sufficient seems to be known of the southern Asiatic peoples to enable a rough outline of the history and origin of the Formosan aborigines to be given. The popular theory that they are a branch of the Malay race is misleading and inadequate.

Two of the main branches of the human race are directly involved—the Caucasian and the Mongoloid. A third also was possibly implicated, the most primitive, or Negroid race. At a time of which we can only conjecture the antiquity, two Negroid races, one of dwarfs and one of black men, inhabited Malaysia. The dwarfs have been called Indo-Oceanic Negritoes, and were brown, woolly-haired people; a few still exist in the Malay Peninsula, the Andamans, Java and the Philippines. Possibly, they reached Formosa and were its first inhabitants, for several dark, dwarf women, who appeared to be enslaved by the rest of the village, were observed among the Taiyal. The blacks probably did not reach Formosa, although the inhabitants of the adjoining

island of Botel Tobago are of an unusually dark colour and one or two have been seen with frizzy hair.

To the north of the Archipelago, in the temperate zone, lies a great table-land, the central Asian plateau, bounded by huge mountain ranges and extending almost the width of Asia through its centre. In due course, in post-Pliocene times, was evolved upon its northern slopes and valleys a narrow-headed, light-coloured type of man, the Proto-Nordic branch of the Caucasian race. These with two other branches, a darker-coloured race and a broad-headed type—the Mediterranean and Alpine races—moved westwards under pressure of population and climatic changes, and together dominated Europe.

There was, however, another Caucasian branch which sprang from somewhere on the southern slopes and low-lands of the western plateau. They were "brunet" Caucasians, being of more southern origin, and when the urge of migration came to them, it drove them south-eastwards to still warmer climes, and passing through the north-west gateway of India, they settled upon its fertile plains about 2500 B.C. They were called Indo-Oceanic Caucasians, or *Indonesians*, and from them Hindu and other races were evolved. But again the pressure of population made itself felt, and then began a long period of southward migration to the fertile and luxuriant tropics of the Eastern Archipelago, a migration which still continues to a small extent. The Indonesians moved south-east and took possession of the whole western Archipelago and Cochin China. It was probably part of this race which, several hundred years before the Christian era, moved northwards once more and reached Formosa, where the Negritoes were soon enslaved. Here, they occupied the whole of the fertile western plains, and grew their barley, millet and sweet potatoes, for they were essentially agriculturists rather than wanderers and sea-rovers.

The social life of the Indonesians was highly developed and monogamy was universal among them. Village life was often organized democratically into unions of villages under a head-village, similar to those of Saxon and Hindu races. They worshipped sun gods, and their business was creative rather than destructive. They were more cultured than the present inhabitants of the Archipelago, and it is only where their influence extended that culture now exists. Their last migration was the greatest ever known by sea, for in A.D. 450 they set out in a fleet of canoes, and with a seamanship and daring that is surely unprecedented, skirting the west coast of Sumatra, passed east through Melanesia and out into the South Seas, where they became known as Polynesians, "the noblest of all primitive races." To this day, the Tongans are said to resemble the Taiyals strongly in feature and colour.

THE HOME OF THE REBELS.

This photograph shows the author's party, accompanied by Japanese policemen, following a flooded river towards the neighbourhood of the recent massacre.

There was another route of Indonesian migration; it appears to have been directly eastwards from India. It is unlikely to have been more than a mild infiltration, owing to the nature of the country to be traversed, and it is improbable that China ever saw them in any quantity. But they actually arrived, at any rate in western China, as the Chiarung and Lolo tribes testify; the latter well maintain the credit of their race, possessing still, in spite of their small numbers, a written language and considerable literature of their own. While in South China, I made two trips up-country in Fukien province to investigate a supposed aboriginal tribe called the Yu, or Lan-Lui-Lan. They proved to be a mixed aboriginal race of Mongoloid stock, but in one or two cases the women's features were of a decidedly Hindu type. I had hoped to show an alternative and more direct route over land, by which the Taiyals might have reached Formosa, but the evidence was insufficient.

About 1500 B.C., a Mongolic race of seafarers, the Proto-Malays, appeared and settled upon the coasts of Further India. They were an indolent and improvident race, but were great seafarers and later became no mean agriculturists. They were the first to introduce iron and dug-out canoes into the Archipelago. By the beginning of the Christian era, the Proto-Malays had in turn occupied all the territory

of the Indonesians, dominating them and driving them in all cases from the coastal plains of their islands into the mountains of the interior, or else inter-breeding with them. They exist to-day as the Sundanese and Javanese, and as the Bisayas and Tagalogs of the Philippines. About this time, some Tagalogs crossed over to Formosa, being probably the first branch of this race to reach the island.

To the south, the Proto-Malays had by now mixed extensively with the Indonesians, and this "un-natural connexion," as it is truly called, seems to have produced a virile type, to which the name Proto-Polynesian has been given. These people moved east from Java and colonized Melanesia with a bewildering mixture of Caucasic and Mongolic types, formerly the despair of ethnologists. The last Mongolic invasion of note was that of the Tibeto-Burmans into Indo-China in the eighth century A.D. Later, the Proto-Malays invaded Formosa again, and also Fukien. In 1160, the "true Malays," or Orang Malayu, crossed from Sumatra, and within a hundred years, occupied the whole of the Archipelago, forming the "Malay Empire." There is no evidence that they ever reached Formosa.

The Formosan Proto-Malays, with their superior knowledge and weapons, soon dispersed the Indonesians. The Chinese started definitely to settle in Formosa in 1564, and during the eighteenth century, the Proto-Malays in turn were driven to the mountains or foothills with much barbarity and slaughter. At the present time, therefore, the Indonesian Taiyals, the first to retreat, are the most isolated, and they inhabit the wildest parts of the northern mountains. The social life and culture of the Indonesians inevitably degenerated, until at the present day it would seem

FORMOSANS.

The bare-headed man on the left is of the Malay type, while the two central figures are typical Indonesians. The cock's feathers show that the wearer has taken heads.

JAPANESE GUARDS.

Day and night, apanese soldiers guard a line which surrounds the rebel territory. Little advance has been made into this stronghold during the past seventeen years.

laughable to those on the spot, more especially to the Japanese, to suggest that they can ever have been a cultured race.

Of the successive stages of approach towards civilization through which primitive man has passed, namely the hunting, pastoral and agricultural phases, the Indonesians alone of the inhabitants of the Archipelago had become definitely agricultural. But with the onslaught of armed enemies, they soon reverted, in their new forest homes where food plants were scarce, to the most primitive life of the hunter. Their sacrifices of animals to the sun and harvest gods became human sacrifices to their new war gods, which took the form of head-hunting. A probable relic of their agricultural days is the fact that much vegetable food is still grown by the Taiyals, but only by the women, whose sole implement is the hoe. Possibly for this reason the women are held in high esteem and take a prominent part in the councils of the tribe. Where still untouched by the influence of foreign trade, they maintain their high standard of morality, their village organization, and their virile and independent character, in spite of their being the fiercest fighters and head-hunters in the Far East. The task accomplished by the Japanese, since they first occupied Formosa in 1895, has been the successful subjugation of the Paiwan, Ami, Vunum and other small tribes.

This was not accomplished easily, but was thoroughly carried out. The Japanese police are an admirable body of men, who treat the people well and live on the most friendly terms with them. They have never received sufficient credit for their performance in Formosa. There remains the Taiyal, still unconquered and defiant, cousins of the Polynesians, "the noblest of all primitive races."

Book Reviews.

Rediscovering England. By CHARLOTTE A. SIMPSON. (Ernest Benn. 21*s.*).

(REVIEWED BY PROFESSOR H. J. FLEURE).

The rise of modern geographical study is an attempt to make us interested in the changing world about us, to shed the light of a constructive and scientifically informed imagination on the commonplace, that we have too long taken for granted. Pupils at a school or students of a university will often justify some custom by saying that it has always been so, when those whose memories are longer may know it is but a recent invention, destined to pass away. So, in adult life, we have taken the Lancashire cotton industry and many another British effort for granted, and we are correspondingly upset when we find the foundations of our little world giving way, not to say deliquescing. Had we but maintained and developed the geographical study that was implicit in Defoe and Gilbert White, Cobbett and Jefferies, even at the cost of a little neglect of abstract economics, we might have better maintained that power of looking at ourselves and our affairs objectively, which is one of the prime factors of sound social hygiene. For it is one of the features of our beautiful country that it has inspired amateurs to write of its pleasantness and its heritage from generations long forgotten: those named above, and, in our own day, C. E. Montague, W. H. Hudson, Hilaire Belloc, Harold Peake, Rider Haggard, all of whom, but not Hardy, are often quoted in Miss Simpson's book.

She sets out to give us a picture of the way in which the rocks of the country have affected its life and work in different parts, and she gives successive chapters to the South East, Hampshire and the Lower Thames, the Midlands, and the North. Then she shows us how village sites, and even sometimes forms, and parish boundaries are dependent upon geographical factors and their interaction with the economic life of man. Styles of cottages, facts of rural industries, diversities of cultivation, markets and fairs all get their turn from the authoress, though she does not set out to write systematically. Miss Simpson does not seem to be specially interested in industrial areas, as she has written mainly to tempt people to go "really truly exploring" as Kipling has it. May we hope that either she, or some other enthusiast, will take up the wondrous story of the industrial cities and make us thrill to it as we do to many a page in this book.

It is true that we often feel the gist of the story is eluding us, for Miss Simpson concerns herself primarily with influences of place, and does not say much about the time at which a thing happened or a town grew; but now and then she lets herself go, as in the case of Stroud (Glos.) and Rugby. Would that she had found space to let herself go a little more in the case of Oxford! There is needed, more than many other treatises, a book on Oxford from the point of view of the student of place, who, none the less, knows the sequence in time of the events in the evolution of the city.

Miss Simpson makes a great feature of quotations, which are often very well chosen, to lead the willing reader on to some of the treasures of English literature of the countryside, and one hopes that she may make many a student get and enjoy "The Right Place," if he does not already know that gem from C. E. Montague's pen. We could, perhaps, wish that the authoress had related her work a little more to Mackinder's vital book on "Britain and the British Seas," but she has probably thought that the less systematic she is the better it will be for her admirable purpose.

A coloured frontispiece gives the rocks and soils of the Oxford district, not from the point of view of geological sequence, but arranged to show the materials determining the character of the surface, and many a teacher and student will want to use this little map and enlarge it. A pocket at the end of the book contains the official geological map of the British Isles, very useful for following the argument even if its scale be rather small for the purpose.

The price of the book might be reduced with advantage, and some proof corrections should be made if, as it is to be hoped, a second edition is needed.

Jorullo: The History of the Volcano. By HANS GADOW. (Cambridge University Press. 7*s.* 6*d.*).

Geology, as we now understand the term, may be said to have commenced when James Hutton showed that the rocks of the earth's crust have been built up by the operation of processes similar to those by which the present surface features have been made, and by which these features are perpetually being modified. Hutton wrote towards the end of the eighteenth century, and since his time one of the most interesting lines of geological investigation has been that concerned with the reconstruction of the physical geography of various parts of the world at successive periods in the earth's history; this has been accomplished by interpreting the rocks and their structures in the light of similar rocks and similar structures that are being produced where the appropriate conditions prevail to-day.

It is possible to study the process of denudation almost everywhere, and there are many places where volcanic activity is manifest, but, although the history of the spread of living things is an important element in geological history, as the abundance of fossils would at once suggest, very few natural processes result in the exposure of a lifeless tract, the invasion of which by plants and animals can be studied. The retreat of a glacier provides such a tract, and the valley floor exposed by the recent shrinkage of the Rhone glacier above Gletsch at once suggests itself as an instance. But in a region of this nature, where neither the soil condition nor the climatic environment is hospitable, the re-population of the region from which the ice had cleared the former inhabitants is necessarily slow. In strong contrast we have the case of a tract, such as the neighbourhood of Jorullo, the scene of a series of volcanic eruptions that must have entirely obliterated all living things, but where, owing to the geniality of the climate, the profusion of life in the surrounding districts, and the fertility of the soil arising from the decomposition and disintegration of volcanic materials, everything was favourable to the re-population of the devastated area.

These introductory remarks will serve to illustrate the importance of a book like "Jorullo" for it is a record of the investigations made by a competent observer, and it has a message for the botanist and for the zoologist as well as for those concerned principally with the operation of geological processes.

The book opens with an account of the formation of the Volcano of Jorullo, in Mexico. There are no local records of volcanic activity before 1759 A.D., but in that year there commenced a series of eruptions which continued for some years, and which, in addition to building a number of volcanoes, completely buried with lava, ashes, and dust more than five

square miles of land that had previously been famous for its fertility. The account of the eruption and its effects is based upon the author's examination (in the light of the present evidence) of eye witnesses' accounts, and some of the observations made by previous visitors, including Humboldt, are critically examined. Then follows an account of the present vegetation and animal life of the surrounding region, which was studied with a view to determining the sequence and rate of re-population of the devastated area.

The author, with his wife, spent a month at Jorullo, and it might seem, in view of the complexity of the problem, that such a period is far too short to permit of investigations sufficiently exhaustive to justify the drawing of important conclusions. But the work was most intensively carried out, and the late Dr. Gadow was specially qualified by experience to deal with some of the most important elements of the fauna, the amphibia and the reptiles. He fully realized the imperfection of some of his evidence, and made due allowances in the conclusions he drew.

The district was very fertile before the eruption, and was occupied in part by the Hacienda of Jorullo. Although for many years after the eruption the region was naturally quite sterile—for the rocks remained hot for a surprisingly long time—plants and animals have now re-installed themselves, for the most part, by purely natural means. Some interference with the movements of animals, however, has resulted from cultivation. For example, in cultivated areas the removal of the shrubs that had established themselves, and the selective control of the vegetation exerted by the planters, has acted as a barrier to animals that might have entered the region, especially from the south-east. Some interesting plant associations are recorded: certain areas thickly covered by volcanic sands afforded favourable ground for the germination of seeds of palms, and on the axillae of the decayed leaves of the palms orchids had established themselves, giving rise to a band of those plants encircling the stem of the palm.

As far as reptiles and amphibia are concerned, it appears that, comparing the present fauna of the devastated area with that of the adjacent country, more than half the species that might be expected to occur have been found, but on the whole the present representatives are mostly low-level forms that have gone up the valleys. High level forms are not represented. Taking all the evidence into consideration, it would seem that an area of the shape and size of that laid waste by the eruption of Jorullo can be covered with vegetation in forty or fifty years when vegetation once begins to re-establish itself. Compared with Krakatoa the barren period may seem long and the recovery slow, but this is probably due to the difference in rainfall enjoyed by the two regions.

This little book deserves close study, and the plain style in which it is written makes it easy to read and leaves one in no doubt as to what the author wished to convey. It could with advantage have been provided with an index.

Man and the Stars. By H. T. Stetson, Director of the Perkins Observatory, Ohio. (McGraw-Hill. 12*s.* 6*d.*).

This book attempts to cover the whole field of descriptive astronomy from the earliest times. Much of the story is told only in brief outline, but the descriptions of certain critical epochs are fairly full, notably that of the great revolution in astronomical thought brought about by the successive contributions of Copernicus, Tycho, Kepler, Galileo and Newton, and the more recent revolutions which followed the application of the spectroscope to astrophysical problems, and the application of the new doctrines on the nature of the atom to the difficult question as to how stars can maintain their stupendous outpouring of light and heat through countless millions of years. The question of life in other worlds is considered; it is shown that the measures of the temperature on Mars by Coblentz, Lampland, Pettit and Nicholson make the idea of its habitability more plausible than had been thought before.

The effect of sunspots on wireless transmission is a matter that has not hitherto been studied in astronomical text-books. Evidence is produced to show that sunspot activity tends to lower the Kennelly-Heaviside layer, and to interfere with long-distance reception. It is suggested, however, that the effect may be reversed when very long waves are employed. The final chapter, "Has Science Displaced Religion," though a little vague, at least tends to show that increasing knowledge of the marvels of creation has brought about a more reverent tone among scientific writers than was common half a century ago. The book is illustrated with portraits of eminent astronomers, and with photographs of eclipses, star-clusters and nebulae.

A few misleading statements should be pointed out: The speed necessary to carry Saturn round the Earth in a day is only one-third of the speed of light (p. 14). Kepler was not born till 1571, so he could not have observed the comet of 1531 (p. 69). Laplace's nebular hypothesis was put forward about 1795; it began to be doubted at least as early as the "'eighties" of the last century, through the work of Fouché and others. The words "a century and a half" are an exaggeration (p. 92). It is erroneously stated that some minor planets have retrograde movement; the shortest period known for any body with retrograde movement round the sun, is thirty-three years for Tempel's comet of the November meteors (pp. 96 & 98). The use of the centigrade thermometer for stellar temperatures is so general that it tends to confusion if their temperatures are given on the Fahrenheit scale (p. 126).

English Romanesque Architecture before the Conquest. By A. W. Clapham, F.S.A. (Clarendon Press. 30*s.*).

Those who are still inclined, in spite of Professor Baldwin Brown and others, to dismiss all our pre-Norman architecture as poor and barbarous, will assuredly be converted by this excellent book. The long series of fine photographs, supplemented by fifty diagrams and plans, would almost speak for itself. But the text, fortified by the author's experience as technical editor to the Historical Monuments Commission, is so luminous and complete as to put the subject on a new footing. He shows that the early churches of Kent and Essex—as at Canterbury, Reculver, and Bradwell—were built by imported masons on a plan that had been adopted in Ravenna and North Africa but not in Rome. He draws special attention to the church at Brixworth, "perhaps the most imposing architectural memorial of the seventh century yet surviving north of the Alps." The few early Northumbrian churches, as at Jarrow and Escomb, are more primitive, and show the influence of Merovingian Gaul.

Mr. Clapham devotes an interesting chapter to the fascinating Anglian crosses, especially at Bewcastle and Ruthwell. On the whole, he would date them earlier than 700, with Professor Baldwin Brown, rather than after 700, with Mr. Collingwood. In view of their technical merit, unequalled elsewhere in that

age, he would assign them to foreign sculptors, assisted perhaps by native pupils. Two centuries later came another series of sculptured stones, headed by the magnificent wheel-cross at Gosforth, which are definitely Scandinavian rather than Byzantine in character.

English architecture from the ninth century onwards was strongly influenced by Carolingian models. The author goes so far as to say that "in the minor arts the Norman Conquest was little short of a catastrophe," and that it probably threw back the major art of architecture. As the larger Saxon churches were all demolished when the great age of Gothic building began, this statement cannot be verified. But the general plan and ornamentation of the later Saxon church can be demonstrated from the smaller examples that survive, and this the author has done in a lucid and scholarly fashion. The nave and chancel were usually square, and high in proportion to their width, as at Bradford-on-Avon, perhaps the best known of all the tenth-century churches which remain. Pilasters and double-splay window-openings are familiar signs of Saxon work.

The author is unable to say whether the queer pyramidal roof of the tower at Sompting, so common in early Rhenish churches, was the normal Saxon type, since it is a unique survival in England. The probabilities, however, are against the belief that the builders in this remote Downland village were more influenced by Rhenish models than their fellows. This book, which raises many such problems, will at once become the standard guide for all students of our early architecture.

The Science of Life. By H. G. Wells, Julian Huxley and G. P. Wells. (Cassell. 21s.).

When the contents of this book originally appeared in fortnightly parts, it aroused widespread interest, and its publication in a stout and attractive binding will be welcomed by those who are wise enough to consider that a guinea is not too much to pay for its permanent preservation. The book is rather a formidable task for the reviewer, and not the least difficult problem is to know where to begin. Comment is superfluous, and to attempt even the baldest summary of its contents would, to say the least, be a laborious, though by no means tedious, undertaking.

The work is divided into nine books, each containing six or seven chapters which are themselves divided into sections. In an introduction, the range and nature of living things is studied, and in succeeding books the authors deal in turn with the living body, the chief patterns of life, evolution, the history, adventures, and spectacle of life, health and disease, behaviour, feeling and thought, and the biology of the human race. In fact, there seems to be ample justification for the publishers' claim that "the book deals with the whole history of human life and all the lesser life on and in the land and in the sea and air. In doing so, it covers every branch of modern enquiry and research."

When, a few years ago, Mr. Wells published "The Outline of History," he brought to many for the first time the realization that they lived on a wider stage than they had supposed; that the things of the present in which their activities mingled had a greater significance than they had realized. For it covered a broader world than that with which most of the previous popular outlines had thought it necessary to deal. But it is not only in the field of human history that science has expanded; realization of the nature of life and knowledge of its processes have deepened and intensified, and a growing volume of information about life has become available. Much of this information is still largely inaccessible to the popular reader. The present book is an attempt to describe life, to tell what is definitely known about it, and to discuss what has been suggested about it, and "to draw just as much practical wisdom as possible" from the account which it gives.

The "triplex author" claims to be wedded to no creed, but has attempted to tell what is believed to be the truth about life so far as it is at present known. It is explained in an introduction that the book has been written with a strenuous effort to be clear, complete and correct; each of the authors has been carefully watched by his associates with this in view. But they do not pretend to want to escape from their common preconceptions, and "the reader will not have made the best use of the book unless, instead of accepting its judgments, he uses them on which to base his own." The book is copiously illustrated in tone and line, and contains many useful and interesting diagrams.

Essays in Philosophy. Edited by Thomas Smith and William Kelley Wright. (Open Court. 16s.).

The University of Chicago, now nearly forty years old, could have no better testimonial to its usefulness than the volume of essays by seventeen of its old philosophical students. For the first and most important duty of a university to the community which it serves is to encourage clear and courageous thinking, and that is precisely what this volume shows. The essayists cover a wide variety of subjects, some technical and others general—such as the paper "On Art as Expression," by Miss Kate Gordon, which heads the list. But all alike are frank, sincere, and lucid in expression. "A Critique of Pure Science," by Dr. C. E. Ayres, is notable for its drastic treatment of the pretensions of some scientists, who would apply mechanistic methods to morals and religion. "Theologically, morally, socially disenchanted persons are heretics. It may be that heresy is the mark of a 'social scientist.' Perhaps the difference between a religious man and a 'religious scientist' is that one is a believer and the other is an unbeliever. But this does not alter the fact that heresy is a form, not of mechanics, but of theology."

Dr. J. R. Geiger's "Prayer, Auto-suggestion, and God" is equally outspoken in a kindred sense. "Whether the scientist neglects his religion or not, there is always a tendency for him to carry over into the religious situation too much of the mental paraphernalia which he finds to be useful in science. For example, one of the most useful attitudes which the scientist can maintain for scientific purposes is a degree of caution which in practice really amounts to incredulity or doubt. In religion, however, such an attitude is worse than useless." Another valuable contribution is that of Dr. Wesley C. Mitchell, on "Postulates and Preconceptions of Ricardian Economics," which not merely discusses Ricardo's motives, but raises the eternal question of values—whether economic or social or both.

Dr. A. K. Rogers' "Instrumentalism and Ideals" reflects a certain disillusionment with the philosopher in politics, notably represented by the late President Wilson, and suggests that the moral philosopher and the politician has each his own sphere—since "politics must concern itself primarily with the application of means rather than with the uncovering and enforcing of new and better ways of living." However, Wilsons are rare in the political arena.

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